

**GROVER'S
IRON & TIMBER
RAILWAY SUPERSTRUCTURES**

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IRON AND TIMBER RAILWAY SUPERSTRUCTURES, AND General Works;

Giving Dimensions and Quantities for the Standard 4ft. 8½in. Gauge,
and the Metre 3ft. 3¾ in. Gauge;

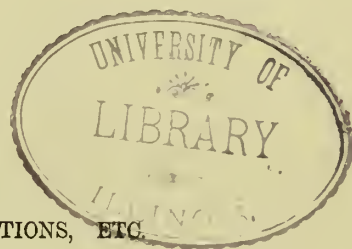
Also applicable for Light Railways, Steam Tramways, etc.;

WITH SOME EARTHWORK TABLES, AND OUTLINE OF
A SPECIFICATION AND REQUIREMENTS.

BY

J. W. GROVER, M. INST. C.E.,

AUTHOR OF ESTIMATES, ETC., OF RAILWAY BRIDGES, CULVERTS, STATIONS, ETC.



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INTRODUCTION.

THIS Work is intended to form a continuation of the "Estimates and Diagrams of Railway Bridges, Culverts, and Stations," by the same Author, and is for the purpose of facilitating the Engineer's calculations in designing and estimating for new Railways, either on the Standard or Narrow Gauge.

Railway Construction in future is likely to have especial requirements. The demand for light or cheap Lines is on the increase, and Agricultural Steam Tramways are being built by Landowners to develop their Estates.

The Narrow Gauge—less than 4 ft. 8½ in., probably ranging from 3 ft. to 3 ft. 6 in.—will become general in many new countries; and even here curves and gradients heretofore unknown in general practice are being daily adopted to surmount the obstacles of nature. And the Engineer finds that he requires concise information in a portable form to assist him in framing rapidly his Reports and Estimates.

Heavy Earthworks being generally avoided, the calculations will be more dependent on the costs of surfacing, especially on sidelong ground, where the contour of the hills has been followed. For assisting this a Table of Earthworks is given, by which very great lengths may be calculated in a short time approximately, with much less labour than is required in the ordinary way.

The works given are taken from those generally which have been designed for actual execution, many of them having been carried out by the Author and others.

The quantities, weights, and rolling and fixed loads being given in each case, estimates, comparisons, and alterations can with facility be made, and the difference between the Standard and Metre Gauges be seen at a glance.

The examples in this volume, taken with those already referred to in the preceding Treatise, by the same Author, will, it is believed, cover those superstructures most generally required in actual practice in their primary forms. With these alone is it possible to deal in a concise and portable volume. Special cases must always require their own treatment and exercise judgment.

The Ironwork is given with details and weights, so as to be practically available for the Manufacturers and Contractors.

IRON & TIMBER RAILWAY SUPERSTRUCTURES & GENERAL WORKS.

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IRONWORK:—

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	3	ditto	dittoEnlarged details
	4	ditto	67' 6" Wrought Iron GirderDiagram.
	5	ditto	dittoGeneral details.
	6	ditto	dittoEnlarged details.
	7	ditto	100 feet Wrought Iron GirderDiagram.
	8	ditto	dittoGeneral details.
	9	ditto	dittoEnlarged details.
	10	Standard Gauge 4' 8 $\frac{1}{2}$ "	60 feet Wrought Iron GirderDiagram and general details.
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	18	ditto	dittoEnlarged details.
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	20	ditto	dittoGeneral details
	21	ditto	dittoEnlarged details.
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	27	ditto	One General Abutment in Brick or Stone for an embankment from 5' 0" to 40 feet high for Iron Girders.

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29	ditto	50 feet Timber Viaduct.
30	ditto	37 feet Timber Viaduct.
31	ditto	20 feet Spans for Viaduct.
32	ditto	10 feet to 20 feet openings.
33	ditto	1' 6", 2' 0" and 3' 0" diameter timber trunks. 10 feet Occupation Gate.
34	ditto	Public Road and Crossing Gates.
35	ditto	Fencing and Palisading of various sorts. Cattle Pen.
36	ditto	Rough Culverts and Cattle Arches in scabbled masonry. Occupation Bridge.
37	ditto	General Iron Pier, from 15 feet to 105 feet high
		Earthwork Tables for Preliminary Calculations.
		Outlines of Specifications.
		Heads of requirements for Junctions, Stations and Fittings.
		Tender.

PLATES 1, 2, 3.

METRE GAUGE (3' 3 $\frac{3}{8}$ ")

Road on Top.

40 FEET SPAN GIRDER.

Angle Irons and Bars, Rivets, and Gibs and Cottars.

Rolling Load . . . 0·5 tons per foot run on each Girder.

Fixed Load . . . Including ballast and sleepers, taken at 4·0 tons distributed on each Girder.

Strain 5 tons per square inch not exceeded for either compression or tension ; holes in all cases being deducted.

ESTIMATED WEIGHTS.

WROUGHT IRON:—

Tons.		Tons.
1·68	in one Girder,	in two 3·36
0·25	Cross Bracing in one span	0·25
1·64	in Cross Girders and Handrail in one span	1·64
0·16	in bolts, spikes, screws in planking	0·16
Total Wrought Iron in one span		5·41
160 ft. of 1 in. Tubing for Handrail.		

CAST IRON:—

122 lbs.	in one shoe for lewis bolts, etc.	
	for four in one span	Tons. 0·218

TIMBER:—

In one span	176 cub. ft.
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As the weights in this Bridge are small, it will be necessary to specify a superior description of iron and workmanship.

PLATES 4, 5, 6.

METRE GAUGE (3' 3 $\frac{3}{8}$ ") Road on Top.

67 FEET 6 INS. SPAN GIRDER. Forged Links and Pins.

Rolling Load . . 0.45 tons per foot run on each Girder. (This is equal to 0.5 tons per foot for 50 feet, and 0.3 tons per foot for the remainder of the span).

Fixed Load . . Including ballast and sleepers, taken at 8 tons distributed on each Girder.

Strain . . . 5 tons per square inch not exceeded for either compression or tension ; holes in all cases being deducted.

ESTIMATED WEIGHTS.

WROUGHT IRON:—

Tons.		Tons.
4.48	in one Girder	in two 8.96
0.46	Cross Bracing in one span	0.46
2.74	Cross Girders and Handrail	2.74
0.25	in bolts, spikes, screws in planking	0.25
Total Wrought Iron in one span		12.41

278 feet run of 1 inch Tubing for Handrail.

CAST IRON:—

Tons.		Tons.
0.093	in Stars for one Girder	for two 0.186
0.49	in one Bearing Plate	for four 1.96
		2.146
0.25	in one foot of 3' 6" Cylinder	for two Cylinders 0.50
8 lbs.	allow for bolts in 1 foot of one cylinder	for two 16 lbs.

TIMBER:—

In one span 278 cub. ft.
The Cylinders should be filled with Concrete in Hydraulic Lime.

As the weights in this Bridge are small, it will be necessary to specify a superior description of iron and workmanship.

PLATES 7, 8, 9.

METRE GAUGE (3' 3 $\frac{3}{8}$ ")

Road on Top.

100 FEET SPAN GIRDER.

Forged Links and Pins.

Rolling Load . . . 0·4 tons per foot run on each Girder. (This is equal to 0·5 tons per foot for 50 feet, and 0·3 tons per foot for the remainder of the span.)

Fixed Load . . . Including ballast and sleepers, taken at 13 tons distributed on each Girder.

Strain 5 tons per square inch not exceeded for either compression or tension ; holes in all cases being deducted.

ESTIMATED WEIGHTS.

WROUGHT IRON :—

Tons.		Tons.
8·13	in one Girder	in two 16·26
0·55	Cross Bracing in one span	0·55
4·05	Cross Girders and Handrail	4·05
0·37	in bolts, spikes, screws in planking	0·37

Total Wrought Iron in one span . . . 21·23

430 feet 4 inches run Tubing for Handrail.

CAST IRON :—

Tons		Tons.
0·093	in Stars for one Girder	for two 0·186
0·68	in one Bearing Plate	in four 2·72
		2·906
0·35	in 1 foot of 5 feet cylinder 1 $\frac{1}{8}$ thick	for two cylinders 0·70
10lbs.	allow for bolts in 1 foot of Do.	for two „ 20lbs.

TIMBER :—

In one span 412 cub. ft.

The Cylinders should be filled with Concrete in Hydraulic Lime.

As the weights of this bridge are small, it will be necessary to specify a superior description of iron and workmanship.

PLATES 10, 11.

STANDARD GAUGE (4' 8½")
60 FEET SPAN LATTICE GIRDER.

Road on Bottom Flanges.
Forged Links and Pins.

Rolling Load . . . 0·75 tons per foot, run on each Girder.
Fixed Load . . . Including ballast and flooring, taken at 10·75 tons on each Girder.
Strain . . . 4 tons per square inch in tension, holes deducted ; 3 tons per square inch in compression, not exceeded.

This Bridge is designed for districts where labour of a skilled nature is difficult to obtain, and where the carriage of heavy pieces is to be avoided, the heaviest piece being a length of the top flange, under 6½ cwt. in weight, and 6 ft. 8 in. long, so as to be easily transported.

All parts are made from uniform templates, thicknesses only varying ; the joints are planed buttfaces, and go together with bolts.

ESTIMATED WEIGHTS.

WROUGHT IRON :—

Tons.		Tons.
6·89	in one Girder in two	13·78
0·46	in one Cross Girder in ten	4·60
	in bolts, spikes, and screws in planking	0·25
Total Wrought Iron in superstructure, in one span . . .		18·63
One roller weighs 29lbs., or 0·012945 ; for a set of four . . .		0·05178
In Bridges of more than one span, add for connection pieces between		
	Girders over Piers—For each pair of Girders	0·2
	Allow No. 24 bolts 1" dia. to each iron pier of 4 piles and bed plate	0·025
	In cast iron piers allow in each joint in piles for 6 bolts, 1" dia.=14lbs	0·00625
	For bracing in piers	0·2

CAST IRON :—

	Tons.
One roller path weighs	0·15
One bed plate	0·175
One foot run of cylinder	0·030385
One flange of cylinder joint	0·02366
One foundation screw	0·10

TIMBER :—

In one span of 60 feet	269 cub. ft.
For each space over piers add	15 cub. ft.

PLATE 12.

STANDARD GAUGE (4' 8½")

Road on Bottom Flanges.

75 FEET SPAN LATTICE GIRDER.

Forged Links and Pins.

Rolling Load . . . 0·75 tons per foot run on each Girder.*Fixed Load* . . . Including ballast and flooring, taken at 15 tons on each Girder.*Strain* . . . 4 tons per square inch in tension, holes deducted; and 3 tons per square inch in compression not exceeded.

This Bridge is designed for districts where labour of a skilled nature is difficult to obtain, and where the carriage of heavy pieces is to be avoided ; the heaviest piece being a length of the top flange under 13 cwt. in weight, and 8 feet 4 inches long, so as to be easily transported.

All parts are made from uniform templates, thicknesses only varying, the joints are planed buttfaces, and go together with bolts.

ESTIMATED WEIGHTS.

WROUGHT IRON:—

	Tons.		Tons.
11·31 in one Girder		in two	22·62
0·488 in one Cross Girder		in ten	4·88
in bolts, spikes, screws, &c. in planking			0·29
Total Wrought Iron in superstructure, in one span			27·79
One Roller weighs 32 lbs. = 0·01417 tons ; for a set of five			0·07085
In Bridges of more than one span, add for connection pieces between			
Girders, over Piers—for each pair of Girders			0·35
Allow No. 24 bolts 1 in. dia. to each iron pier of 4 piles and bed plate			0·025
In Cast Iron Piers allow in each joint in piles for 6 bolts 1" dia.			0·00625
„ „ „ Bracing in Piers			0·25

CAST IRON:—

	Tons.
One Roller path weighs	0·222
One Bed plate weighs	0·266
One foot run of Cylinder weighs	0·0425
One flange of Cylinder joint	0·029
One Foundation Screw	0·20

TIMBER:—

In one span of 75 feet	325 cub. ft.
Each space over Piers	23 cub. ft.

PLATES 13, 14, 15.

STANDARD GAUGE (4' 8½")

Road on Bottom Flange.

100 FEET SPAN LATTICE GIRDER.

Forged Links and Pins.

Rolling Load . . . 0·75 tons per foot run on each Girder.

Fixed Load . . . Including ballast and flooring taken at 46 tons on each Girder.

Strain . . . 4 tons per square inch in tension, holes deducted; and 3 tons per square inch in compression, not exceeded.

This Bridge is designed for districts where labour of a skilled nature is difficult to obtain, and where the carriage of heavy pieces is to be avoided; the heaviest piece being a length of the top flange, one ton in weight, and 11 feet 2 inches long, so as to be easily transported.

All parts are made from uniform templates, thicknesses only generally varying; the joints are planed butt faces and go together with bolts.

ESTIMATED WEIGHTS.

WROUGHT IRON:—

Tons.		Tons.
19·26	in one Girder in two	38·52
0·615	in one Cross Girder	6·15
	in bolts, spikes and screws in planking	0·50
Total Wrought Iron in superstructure in one span . . .		45·17

	Tons.
One roller weighs 34½ lbs. = 0·015395 tons; for a set of six =	0·09237
In Bridges of more than one span, add for connection pieces between	
Girders, over Piers—for each pair of Girders	0·5
Allow No. 24 bolts 1 in. dia. to each iron pier of 4 piles and bed plate	0·025
In Cast Iron Piers, allow in each joint in piles for 6 bolts 1 in. dia. .	0·00625
" " " Bracing in Piers	0·3

CAST IRON:—

One roller weighs	0·294
One bed plate	0·357
One foot run of cylinder weighs	0·05
One flange of cylinder joint weighs	0·03482
One foundation screw	0·3

TIMBER:—

In one span of 100 feet	579 cub. ft.
In each space over piers	add 30 cub. ft.

PLATES 16, 17, 18.

STANDARD GAUGE (4' 8½")

Road on Top.

60 FEET SPAN LATTICE GIRDER.

Rivetted

Rolling Load . . . 0·75 tons per foot run on each Girder.

Fixed Load . . . 21·5 tons distributed on each Girder.

Strain In tension and compression, not exceeding 4 tons per square inch ; rivet holes in all cases being deducted.

ESTIMATED WEIGHTS.

WROUGHT IRON :—

Tons.		Tons.
7·828	in one Girder	in two 15·656
	in eight diagonal cross-braces	0·760
	in two sets of rollers and frames	0·219
	bolts for holding down girders at ends	0·084
	bolts, spikes & screws in planking	0·609
	Total Wrought Iron in one span	17·328

CAST IRON :—

	in two sets of roller paths, bearing plates, &c.	Tons. 0·9
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TIMBER :— 682 cub. ft.

PLATES 19, 20, 21.

STANDARD GAUGE (4' 8½")

Road on Top.

80 FEET SPAN LATTICE GIRDER.

Rivetted.

Rolling Load . . . 0·75 tons per foot run on each Girder.

Fixed Load . . . 30·00 tons distributed on each Girder.

Strain In tension and compression not exceeding 4 tons per square inch ; rivet holes in all cases being deducted.

ESTIMATED WEIGHTS.

WROUGHT IRON:—

Tons.		Tons.
12·41	in one Girder	in two 24·82
	in eight diagonal cross braces	0·832
	in two sets of rollers and frames	0·292
	bolts for holding down girders and roller path to stone work	0·091
	bolts, spikes and screws in planking	0·830
	Total Wrought Iron in one span	26·865

CAST IRON:—

	Tons.
in two sets of roller paths, bearing plates, &c.	1·308

TIMBER:— 930 cub. feet.



PLATES 22, 23, 24.

STANDARD GAUGE (4' 8½")

Road on Top.

100 FEET SPAN LATTICE GIRDER.

Rivetted.

Rolling Load . . . 0·75 tons per foot run on each Girder.

Fixed Load . . . 46 tons distributed on each Girder.

Strain In tension and compression not exceeding 4 tons per square inch ; rivet holes in all cases being deducted

ESTIMATED WEIGHTS.

WROUGHT IRON :—

Tons.		Tons.
19·539	in one Girder	in two 39·078
	in ten diagonal cross braces	1·403
	in two sets of rollers and frames	0·310
	bolts, spikes, screws &c.	1·000
	Total Wrought Iron in one span	<u>41·791</u>

CAST IRON :—

	Tons.
in two sets of roller paths, bearing plates &c.	1·504

TIMBER :— 1,126 cub. ft.

PLATES 25, 26.

WROUGHT IRON GIRDERS OF RIVETTED PLATES, ANGLE AND T IRON.

From 10 ft. to 50ft., Spans inclusive—in increments of 2 ft. 6 in. and 5 ft. each.

Each Girder to carry one ton on the foot run of span, including its own weight.

Strain not to exceed 5 tons on the square inch, after deducting rivet holes.

ESTIMATED WEIGHTS OF WROUGHT IRON IN EACH GIRDER.

No.	Angles & Tee. lbs.	Plates. lbs.	Rivets. lbs.	Total lbs.		Tons.			Span feet.
1	320	195	26	541		0·242			10' 0"
2	510	247	38	795		0·355			12' 6"
3	810	301	55	1,166		0·521			15' 0"
4	1,118	509	81	1,708		0·763			17' 6"
5	1,350	767	106	2,223		0·992			20' 0"
6	1,042	1,363	120	2,525		1·128			22' 6"
7	1,138	2,370	175	3,683		1·644			25' 0"
8	1,247	2,705	198	4,150		1·853			27' 6"
9	1,402	3,398	240	5,040		2·250			30' 0"
10	1,600	3,790	270	5,660		2·527			32' 6"
11	1,700	4,650	318	6,668		2·977			35' 0"
12	1,800	5,687	374	7,861		3·509			37' 6"
13	2,040	6,720	438	9,198		4·105			40' 0"
14	2,357	8,114	523	10,994		4·906			45' 0"
15	2,704	10,400	655	13,759		6·208			50' 0"

PLATE 27.

ONE GENERAL ABUTMENT IN BRICK OR STONE, FOR VARIOUS HEIGHTS.

The superstructure (without the girders), requires 4·83 cubic feet of Timber for 1 foot run of span; and 10lbs. Wrought Iron in bolts and fastenings.

ESTIMATED QUANTITIES

For various heights of Banks, allowing in each case 2 ft. 6in. depth of foundations besides.

Height of Bank.		Excavation in Foundations.	Stone in Caps of Pilasters, bedstones, &c.	Brickwork or Stonework.
Feet.		Cub. Yards.	Cub. Feet.	Cub. Yards.
5	AA	13	38	23½
10	BB	21	38	49
15	CC	27	38	85
20	DD	35	38	136½
25	EE	42	38	202
30	FF	52	38	278½
35	GG	65	38	379

In all cases allow for backing up the brickwork with earth behind the wall as it proceeds.

The above figures are for one abutment only, and the design is suitable for ordinary soils, but not for wet clays.

PLATE 28.

STANDARD GAUGE (4' 8½")

Road on Top.

80 FEET SPAN TIMBER TRUSS BRIDGE.

Rolling Load . . . 1½ tons per foot run of bridge.

Fixed Load . . . ¾ ton per foot run of bridge.

Strain on Timber . In tension or compression not exceeding 500 lbs. per square inch.

For metre gauge the general dimensions of the bridge and abutments to be preserved, but the timbers to be 10 inches × 10 inches instead of 12 inches × 12 inches, and all other timber scantlings to be reduced in the same proportion.

Rolling Load . . . 1 ton per foot run of bridge.

Fixed Load . . . ½ ton per foot run of bridge.

ESTIMATED QUANTITIES.

	Standard Gauge.	Metre Gauge.
Timber	2445 cub. ft.	1698 cub. ft.
Wrought Iron in hand rail, tie rods, bolts &c. .	2·95 tons.	2·5 tons.
Gas piping 1 in. dia.	500 ft. run	500 ft. run
Coursed rubble on face in mortar	282 cub. yds.	282 cub. yds.
Dry rubble at back	450 cub. yds.	450 cub. yds.
Excavation in foundations	125 cub. yds.	125 cub. yds.

Allow price for fixing at height above ground.

PLATE 29.

STANDARD GAUGE (4' 8½").

Road on Top.

50 FEET SPAN TIMBER VIADUCT, WITH STONE PIERS.

Rolling Load . . . 1½ tons per foot run of bridge.

Fixed Load . . . ¾ ton per foot run of bridge.

Strain on Timber . in tension or compression, not exceeding 500 lbs. per square inch.

For metre gauge the general dimensions of the viaduct and piers to be preserved, but the timbers to be 10 inches × 10 inches, instead of 12 inches × 12 inches, and all other timber scantlings to be reduced in the same proportion.

Rolling Load . . . 1 ton per foot run of bridge.

Fixed Load . . . ½ ton per foot run of bridge.

ESTIMATED QUANTITIES IN ONE SPAN OF 50 FEET.

	Standard Gauge.	Metre Gauge.
Timber	948 cub. ft.	660 cub. ft.
Wrought Iron in handrail, tie rods, bolts, &c. .	2·157 tons.	1·777 tons.
Masonry in brickwork in one pier 50 ft. high .	178 cub. yds.	178 cub. yds.
Excavation in foundations	36 cub. yds.	36 cub. yds.

Allow price for fixing at height above ground.

PLATE 30.

STANDARD GAUGE (4 ft. 8½ in.)

Road on Top.

37 FEET SPAN TIMBER VIADUCT, WITH STONE OR BRICK PIERS.

Rolling Load . . . 1½ tons per foot run of bridge.

Fixed Load . . . ¾ ton per foot run of bridge.

Strain on Timber . In tension or compression not exceeding 500 lbs. per square inch.

For metre gauge the general dimensions of the viaduct and piers to be preserved, but the timbers to be 10 inches × 10 inches instead of 12 inches × 12 inches, and all other timber scantlings to be reduced in the same proportion.

Rolling Load . . . 1 ton per foot run of bridge.

Fixed Load . . . ½ ton per foot run of bridge.

ESTIMATED QUANTITIES IN ONE SPAN OF 37 FEET.

	Standard Gauge.	Metre Gauge.
Timber	738 cub. ft.	512 cub. ft.
Wrought Iron in handrail, tie rods, bolts, &c. .	1·013 tons.	0·813 tons.
Masonry or brick work in one pier 22 ft. high .	54 cub. yds.	54 cub. yds.
Excavation in foundations	15 cub. yds.	15 cub. yds.

Allow price for fixing at height above ground.

PLATE 31.

STANDARD GAUGE (4' 8½"). Road on Top.

20 FEET SPAN TIMBER VIADUCT.

- Rolling Load . . 1½ tons per foot run of bridge.
- Fixed Load . . ¾ ton per foot run of bridge.
- Strain on Timber . In tension or compression not exceeding 500 lbs. per square inch.

For metre gauge the general dimensions of the viaduct to be preserved, but the timbers to be 10 inches × 10 inches instead of 12 inches × 12 inches, and all other timber scantlings to be reduced in the same proportion.

- Rolling Load . . 1 ton per foot run of bridge.
- Fixed Load . . ½ ton per foot run of bridge.

ESTIMATED QUANTITIES IN ONE SPAN OF 20 FEET.

	Standard Gauge.	Metre Gauge.
Timber	334 cub. ft.	232 cub. ft.
Wrought Iron in hand rail, tie rods, bolts, &c. .	0·481 tons	0·390 tons.

PLATE 32.

STANDARD GAUGE (4' 8½").

Road on Top.

VARIOUS TIMBER OPENINGS FOR FOOTPATHS, CULVERTS, CATTLE CREEPS.

Rolling Load . . . 1½ tons per foot run of bridge.

Fixed Load . . . ¾ ton per foot run of bridge.

Strain on Timber . in tension or compression not exceeding 500 lbs per square inch.

For metre gauge the general dimensions of the openings to be preserved, but the timbers to be 10 inches × 10 inches, instead of 12 inches × 12 inches, and all other timber scantlings to be reduced in the same proportion.

Rolling Load . . . 1 ton per foot run.

Fixed Load . . . ½ ton per foot run.

ESTIMATED QUANTITIES.

STANDARD GAUGE (4' 8½").

No.	Clear height in feet.	Span in feet.	Timber in cubic feet.	Timber, per ft. run of span in cubic feet.	Wrought Iron, in bolts and ties.
1	5	10	300	30	600 lbs=0·270 tons
2	10	10	350	35	700 lbs=0·313 tons
3	10	15	377	25	754 lbs=0·337 tons
4	12	Two of 15	741	24	1,482 lbs=0·662 tons
5	5	20	402	20	804 lbs=0·360 tons
6	12	Two of 20	898	23	1,796 lbs=0·800 tons

METRE GAUGE.

1	5	10	209	21	417 lbs=0·190 tons
2	10	10	243	24½	486 lbs=0·218 tons
3	10	15	262	17½	524 lbs=0·234 tons
4	12	Two of 15	515	17	1,030 lbs=0·460 tons
5	5	20	280	14	558 lbs=0·250 tons
6	12	Two of 20	624	15½	1,247 lbs=0·555 tons

PLATE 33.

TIMBER TRUNKS, 1' 6", 2' 0" AND 3' 0" DIAMETER.

OCCUPATION GATE 10 FEET WIDE.

PLATE 34.

PUBLIC ROAD CROSSING
GATES.

PLATE 35.

FENCING AND PALISADING OF VARIOUS SORTS.
CATTLE PEN.

PLATE 36.

ROUGH CULVERTS AND CATTLE ARCHES

Of unwrought stone, in rough work polled with scabbling hammer, suitable for mountain railways, where flags or slate, or superior shale rock, having a good flat bed, can be found on the spot, and where skilled labour is expensive.

The areas of each section are given on the Plate.

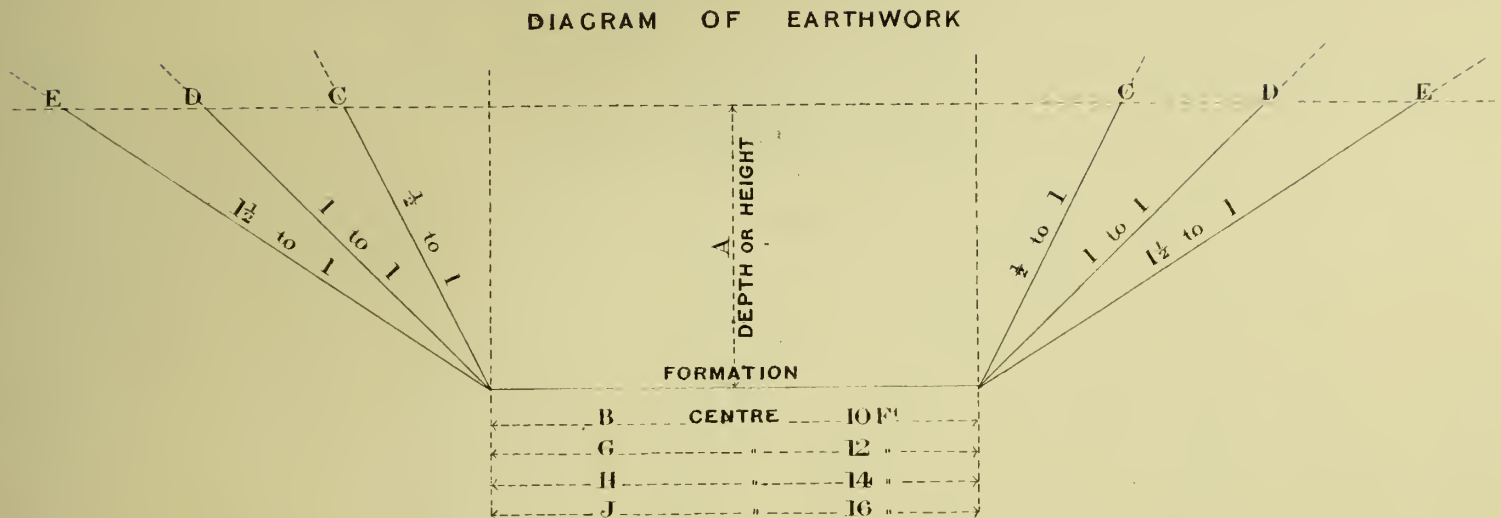
PLATE 37. GENERAL IRON PIER.

ESTIMATED QUANTITIES.

	15 ft. Pier.	25 ft. Pier.	35 ft. Pier.	45 ft. Pier.	55 ft. Pier.	65 ft. Pier.	75 ft. Pier.	85 ft. Pier.	95 ft. Pier.	105 ft. Pier.
	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>k</i>
WROUGHT IRON:—										
One Bearing Girder, &c.....	2·053									
Angle Iron Bracing.....	0·212									
Lewis Bolts to Stone	0·263									
	2·528									
Bolts Column to Column	·087	0·087	0·087	0·087	0·087	0·087	0·087	0·087	0·087	0·087
L Iron Bracing		0·212	0·212	0·212	0·212	0·212	0·212	0·212	0·212	0·212
Diagonal Flat Bracing	0·732	·749	·767	·785	·803	·821	·856	·892	·928	·961
Rolled Joists	·677	·715	·753	·804	·854	·904	·955	1·006	1·056	1·107
	4·024	1·763	1·819	1·888	1·956	2·024	2·110	2·197	2·283	2·367
		4·024	5·787	7·606	9·494	11·450	13·474	15·584	17·781	20·064
Total Wrought Iron in Piers ...	4·024	5·787	7·606	9·494	11·450	13·474	15·584	17·781	20·064	22·431
CAST IRON.										
In Six $\frac{3}{4}$ " Columns	2·832									
Six Foundation Columns	1·872									
	4·704									
4·704 + 2·832		7·536								
7·536 + 2·832			10·368							
10·368 + 3·126				13·494						
13·494 + 3·126					16·620					
16·620 + 3·126						19·746				
19·746 + 3·306							23·052			
23·052 + 3·306								26·358		
26·358 + 3·306									29·664	
29·664 + 3·306										32·970
Total Weight of Ironwork in different Piers	8·728	13·323	17·974	22·988	28·070	33·220	38·636	44·139	49·728	55·401
	15 ft. Pier.	25 ft. Pier.	35 ft. Pier.	45 ft. Pier.	55 ft. Pier.	65 ft. Pier.	75 ft. Pier.	85 ft. Pier.	95 ft. Pier.	105 ft. Pier.

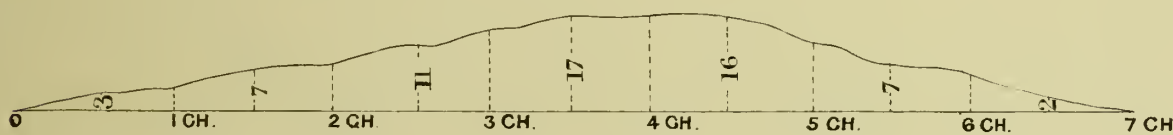
NOTE.—This Pier will carry a load of 200 Tons, or a Standard Gauge Span of 100 feet; allowing a factor of safety of Six.

EARTHWORK TABLES.



The object of these tables is to enable long lengths of Sections to be computed with rapidity ; where the absolute precision required for permanent works is not necessary, but where it is required to estimate only within a small per centage (5 per cent.) The mean depth or height of the cutting or bank in each chain being measured, the corresponding quantity of earthwork will be found in the table.

The central portions being given separately, any formation quantity can be calculated.



EXAMPLE.—Required approximately the quantity in this cutting, taking slopes at 1 to 1, and formation width 10 feet.

	Feet.	Cub. yds.
See Column B + D	3 =	95
"	7 =	291
"	11 =	565
"	17 =	1,122
"	16 =	1,017
"	7 =	291
"	2 =	59
Total	<u>3440</u>	(By Bidder's tables gives 3330.)

Where the ground is very irrègular, shorter lengths than 1 chain may be taken, &c.

DIAGRAM SHOWING EARTHWORK IN SIDELONG GROUND.

On Sidelong Cross Section to find the depth or height, which will represent a corresponding Cutting or Embankment in Level Cross Section.

Let A B represent ground sloping laterally.

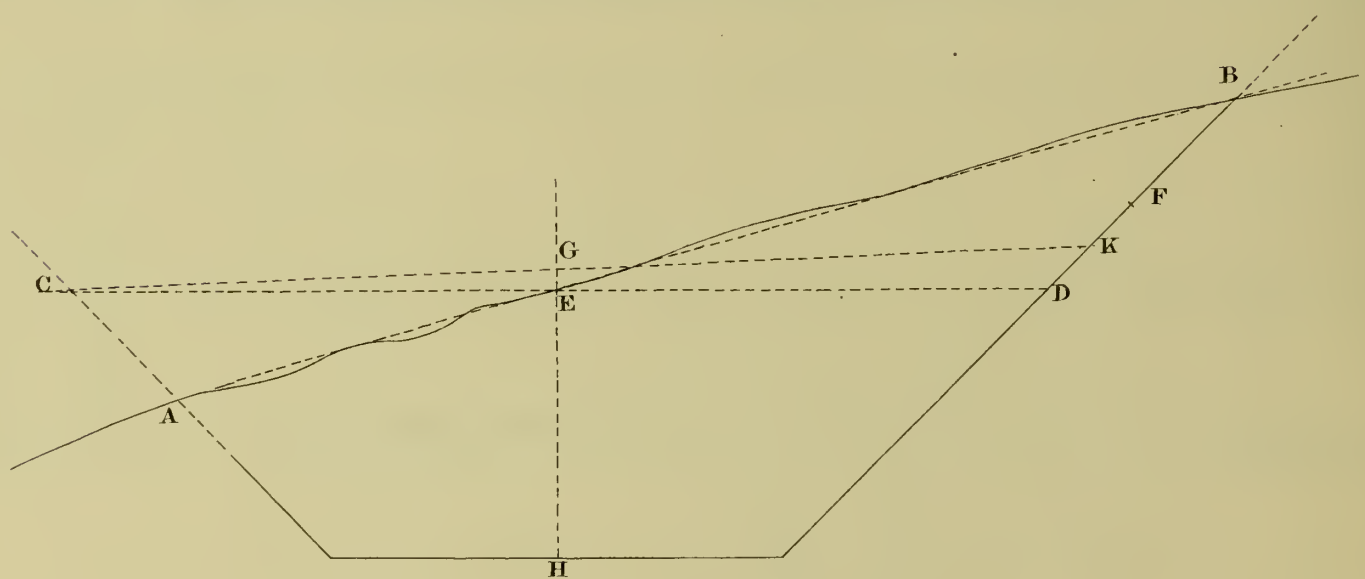
Draw C D horizontal through centre point E.

Make B F = C A.

Bisect D F at K.

Join K C then G H is the height required, nearly—and the line K G C may be substituted for A E B.

And G H is the height on which the quantity from the tables is to be taken.



NOTE.—If greater accuracy is required, repeat the operation, taking K G C as the ground line.

A Depth or Height in feet.	10 Ft. FORMATION.	SLOPES—CUBIC YARDS IN ONE CHAIN.		
	B Cubicyds. in one chain.	C $\frac{1}{2}$ to 1	D 1 to 1.	E $1\frac{1}{2}$ to 1=C+D.
1	24	1	2	3
2	49	5	10	15
3	73	11	22	33
4	98	20	39	59
5	122	31	61	91
6	147	44	88	132
7	171	60	120	180
8	196	78	156	234
9	220	99	198	297
10	244	122	244	366
11	269	148	296	444
12	293	176	352	528
13	318	207	413	620
14	342	240	479	719
15	367	275	550	825
16	391	313	626	939
17	416	353	706	1,059
18	440	396	792	1,188
19	464	441	882	1,323
20	489	489	978	1,467
21	513	539	1,078	1,617
22	538	592	1,183	1,775
23	562	647	1,293	1,940
24	587	704	1,408	2,112
25	611	764	1,528	2,292
26	636	826	1,652	2,478
27	660	891	1,782	2,673
28	685	958	1,916	2,874
29	709	1,028	2,056	3,084
30	733	1,100	2,200	3,300
35	856	1,497	2,994	4,491
40	978	1,956	3,911	5,867

Depth or Height in feet.	10 Ft FORMATION AND SLOPES—CUBIC YARDS IN ONE CHAIN.			CONTINUOUS EMBANKMENT OVER A PLAIN.
	B + C $\frac{1}{2}$ to 1.	B + D 1 to 1.	B + E $1\frac{1}{2}$ to 1.	Cubic yards per mile. $1\frac{1}{2}$ to 1.
1	25	26	27	2,160
2	54	59	64	5,120
3	84	95	106	8,480
4	118	137	157	12,560
5	153	183	213	17,040
6	191	235	279	22,320
7	231	291	351	28,080
8	274	352	430	34,400
9	319	418	517	41,360
10	366	488	610	48,800
11	417	565	713	57,040
12	469	645	821	65,680
13	525	731	938	75,040
14	582	821	1,061	84,880
15	642	917	1,192	95,360
16	704	1,017	1,330	106,400
17	769	1,122	1,475	118,000
18	836	1,232	1,628	130,240
19	905	1,346	1,787	142,960
20	978	1,467	1,956	156,480
21	1,052	1,591	2,130	
22	1,130	1,721	2,313	
23	1,209	1,855	2,502	
24	1,291	1,995	2,699	
25	1,375	2,139	2,903	
26	1,462	2,288	3,114	
27	1,551	2,442	3,333	
28	1,643	2,601	3,559	
29	1,737	2,765	3,793	
30	1,833	2,933	4,033	
35	2,353	3,850	5,347	
40	2,934	4,889	6,845	

Depth or Height in feet.	12 Ft. FORMATION.	12 Ft. FORMATION AND SLOPES—CUBIC YARDS IN ONE CHAIN.			CONTINUOUS EMBANKMENT OVER A PLAIN.
	G Cu. yds. in one chain.	G + C $\frac{1}{2}$ to 1.	G + D 1 to 1.	G + E $1\frac{1}{2}$ to 1.	Cubic yards per mile. $1\frac{1}{2}$ to 1
1	29	30	31	32	2,560
2	59	64	69	74	5,920
3	88	99	110	121	9,680
4	118	138	157	177	14,160
5	146	177	207	237	18,960
6	176	220	264	308	24,640
7	205	265	325	385	30,800
8	235	313	391	469	37,520
9	264	363	462	561	44,880
10	293	415	537	659	52,720
11	323	471	619	767	61,360
12	352	528	704	880	70,400
13	382	589	795	1,002	80,160
14	411	651	890	1,130	90,400
15	440	715	990	1,265	101,200
16	469	782	1,095	1,408	112,640
17	499	852	1,205	1,558	124,640
18	528	924	1,320	1,716	137,280
19	557	998	1,439	1,880	150,400
20	587	1,076	1,565	2,054	164,320
21	616	1,155	1,694	2,233	
22	646	1,238	1,829	2,421	
23	674	1,321	1,967	2,614	
24	704	1,408	2,112	2,816	
25	733	1,497	2,261	3,025	
26	763	1,589	2,415	3,241	
27	792	1,683	2,574	3,465	
28	822	1,780	2,738	3,696	
29	851	1,879	2,907	3,935	
30	880	1,980	3,080	4,180	
35	1,027	2,524	4,021	5,518	
40	1,174	3,130	5,085	7,041	

Depth or Height in feet.	14 Ft. FORMATION.	14 Ft. FORMATION AND SLOPES—CUBIC YARDS IN ONE CHAIN.			CONTINUOUS EMBANKMENT OVER A PLAIN.
	H Cu. yds. in one chain.	H + C $\frac{1}{2}$ to 1.	H + D 1 to 1.	H + E $1\frac{1}{2}$ to 1.	Cubic yards per mile. $1\frac{1}{2}$ to 1.
1	34	35	36	37	2,960
2	69	74	79	84	6,720
3	102	113	124	135	10,800
4	137	157	176	196	15,680
5	171	202	232	262	20,960
6	206	250	294	338	27,040
7	239	299	359	419	33,520
8	274	352	430	508	40,640
9	308	407	506	605	48,400
10	342	464	586	708	56,640
11	377	525	673	821	65,680
12	410	586	762	938	75,040
13	445	652	858	1,065	85,200
14	479	719	958	1,198	95,840
15	514	789	1,064	1,339	107,120
16	547	860	1,173	1,486	118,880
17	582	935	1,288	1,641	131,280
18	616	1,012	1,408	1,804	144,320
19	650	1,091	1,532	1,973	157,840
20	685	1,174	1,663	2,152	172,160
21	718	1,257	1,796	2,335	
22	753	1,345	1,936	2,528	
23	787	1,434	2,080	2,727	
24	822	1,526	2,230	2,934	
25	855	1,619	2,383	3,147	
26	890	1,716	2,542	3,368	
27	924	1,815	2,706	3,597	
28	959	1,917	2,875	3,833	
29	993	2,021	3,049	4,077	
30	1,026	2,126	3,226	4,326	
35	1,198	2,695	4,192	5,689	
40	1,369	3,325	5,280	7,236	

Depth or Height in feet.	16 Ft. FORMATION.	16 Ft. FORMATION AND SLOPES—CUBIC YARDS IN ONE CHAIN.			CONTINUOUS EMBANKMENT OVER A PLAIN.
	J Cu. yds. in one chain	J + C $\frac{1}{2}$ to 1.	J + D 1 to 1.	J + E $1\frac{1}{2}$ to 1.	Cubic yards per mile $1\frac{1}{2}$ to 1.
1	38	39	40	41	3,280
2	78	83	88	93	7,440
3	117	128	139	150	12,000
4	157	177	196	216	17,280
5	195	226	256	286	22,880
6	235	279	323	367	29,360
7	274	334	394	454	36,320
8	314	392	470	548	43,840
9	352	451	550	649	51,920
10	390	512	634	756	60,480
11	430	578	726	874	69,920
12	469	645	821	997	79,760
13	509	716	922	1,129	90,320
14	547	787	1,026	1,266	101,280
15	587	862	1,137	1,412	112,960
16	626	939	1,252	1,565	125,200
17	666	1,019	1,372	1,725	138,000
18	704	1,100	1,496	1,892	151,360
19	742	1,183	1,624	2,065	165,200
20	782	1,271	1,760	2,249	179,920
21	821	1,360	1,899	2,438	
22	861	1,453	2,044	2,636	
23	899	1,546	2,192	2,839	
24	939	1,643	2,347	3,051	
25	978	1,742	2,506	3,270	
26	1,018	1,844	2,670	3,496	
27	1,056	1,947	2,838	3,729	
28	1,096	2,054	3,012	3,970	
29	1,134	2,162	3,190	4,218	
30	1,173	2,273	3,373	4,473	
35	1,370	2,867	4,364	5,861	
40	1,565	3,521	5,476	7,432	



OUTLINE OF

SPECIFICATION

OF THE WORKS NECESSARY FOR THE CONSTRUCTION AND COMPLETION
OF THE **A** AND **B** RAILWAY.

DESCRIPTION OF RAILWAY.

1. The Railway intended to be constructed and included in this Specification will commence in the Parish of [], and terminate in the Parish of [], being a length of main line of [] miles [] chains.

NATURE AND EXTENT OF THE CONTRACT.

2. The Contract will consist of the Formation and Completion of a double (or single) Line of Railway, [] gauge throughout, complete in all respects, and ready for opening for public traffic, including Junctions with existing lines; and at least equal in general character to a [] class English Railway. (The Stations alone being excepted, which are not included in this Contract.)

The Contractor is to provide all Materials, Work and Labour necessary and proper for the execution of such Railway, including all Earthwork, Bridges, Viaducts, Tunnels, and Permanent Way, and all Works relating thereto, or affected thereby; such as Drains, Sewers, Culverts, Waterways, Diversions of Streams, Waterpipes, Gaspipes, Footpaths, Bridge Approaches, Accommodation Works, Temporary Roads and Footways, or any other Communications which may be required (Station Buildings excluded*), also Signal, Mile and Gradient Posts, and Telegraphs, together with [] chains of Sidings in addition to those required at the respective Junctions.

The Company reserve the power to omit from the Contract any portion of the Specified Works which they may become desirous not to construct; and the Engineer shall determine the amount, based upon the Schedule of Prices hereunto attached, which shall be deducted from the contract sum in respect of such omissions.

TIME.

3. The whole of the Contract to be completed in [] months from the date of the order to proceed, under a Penalty of £ [] per Week, for all such time as it may remain uncompleted beyond the period specified.

PAYMENTS.

4. The Works are to be measured up Monthly, and a Certificate, based on the Schedule of Prices hereunto annexed, shall be made out by the Engineer for the value of such works; and payment is to be made to the Contractor within [] days of the issuing of such Certificate at the rate of [] per cent. of the amount thereof; a further sum of [] per cent. being retained until the final Certificate of the Engineer is given.

“ THE ENGINEER.”

5. The word Engineer shall mean the Company's Engineer for the time being; but all instructions relating to the mode of carrying on the work given by his Assistants, Representatives, or Inspectors to the Contractor or his Agent, shall be considered as being given by the Engineer to the Contractor.

LEVELS AND GRADIENTS.

6. The line or course of the Railway as described, and also the levels and gradients of the same, are shown on the Plans and Sections hereunto annexed and numbered []; but power is reserved to the Engineer to vary and make such lateral or vertical deviations from such line or levels within the (Parliamentary or the Concessions) limits of deviation as in his opinion may be necessary or expedient.

* The Station Buildings are usually measured and paid on a Schedule or a Separate Contract.

The value of all additions or deductions caused by such deviations shall be estimated on the Schedule hereunto attached; and the amount so ascertained shall be added to, or taken from the lump contract sum; but no extras or additions will be allowed to the Contractor for which he cannot produce the Engineer's written order.

DRAWINGS AND PLANS.

7. All Drawings, Plans or Sections furnished by the Engineer are to be adhered to, and figured dimensions are to be adopted in preference to scaled dimensions, the Engineer's decision, however, being final in every case of dispute.

CONTRACTOR'S PLANS.

8. The Contractor will be provided with one set of copies of all Plans and Specifications (and Quantities) for his own use.

SETTING OUT.

9. The centre line of the Works will be set out by the Engineer, and the side widths will be put in by him or his Assistants; the Contractor providing the necessary stakes and labour for the purpose.

SUPERVISION.

10. The Contractor shall provide, at his own cost, competent persons, to be approved by the Engineer, to set out the Works in detail in the manner provided for in the Specification and Drawings, and to direct the Works; who shall be responsible for the fixing, upholding, and preserving all such stakes, marks and templates as may be necessary for that purpose, and such persons shall at all times furnish to the Engineer such information as he may require relative to the heights and directions of the lines followed in the Works, the quantity of work executed, and all other matters relating to the setting out, proceeding with and maintaining the Works; and all instructions given by the Engineer or his Assistants shall be promptly and faithfully attended to by the Contractor or his representatives.

ALTERATIONS.

11. The Engineer shall have power to vary or alter, diminish or increase, or abandon any of the Works shown upon the Contract Plans, and Sections, and Drawings, and not already alluded to herein, to an extent not exceeding ten per cent. either way; and any additions or deductions caused by such variations (except for Foundations) shall be calculated on the Schedule, and added to or taken from the Contract sum. With the consent of the Contractor the limit of ten per cent. may be extended either way.

MAINTENANCE.

12. The Contractor is to guarantee the stability of all Works included in this Contract, and to be liable for all risks and accidents to which they may be subject during their progress, and is to maintain the same in good and substantial repair for the space of _____ months from the opening of the Line for public traffic, so far as regards the Earthworks and Works of Art (in respect of the Permanent Way, see special clause); all defects, settlements, flaws in any part being made good, and all Materials which in the Engineer's opinion may be considered defective shall be removed; new Drainage Works being carried out, if required.

TEMPORARY WORKS.

13. The Contractor shall provide all Temporary Works and Roads which may be required, and shall take special care to avoid obstructing the traffic of any of the Railways, Public Roads, Canals, Rivers, or other means of access and communication; and shall hold the Company harmless in the event of any obstruction occurring, or from any accidents or contingent claims arising therefrom.

DISCOVERIES.

14. All Treasures, Coins, Antiquities, or Curiosities, natural or artificial, which shall be discovered during the progress of the work on the land, shall be deemed to belong to the Company, and shall be carefully preserved and handed to the Engineer of the Company.

ARBITRATION.

15. In the event of any difference or dispute arising as to the interpretation of this Contract, or any part thereof, the same shall be referred to the Arbitration of _____ of _____ whose decision shall be final and binding.

LAND, BUILDINGS, AND STANDING TIMBER.

16. The Company will provide Land for the Railway, and for all Works of a permanent character connected therewith; but any other Land which the Contractor may require for carrying out the operations, or for the purpose of Side-cutting, procuring Ballast, or making temporary Roads for carrying Material to or from the Works, or other temporary purposes, is to be provided by the Contractor at his own cost. In doing this, however, he will have the assistance of the Company's (Parliamentary or Concession) Powers, but all expense must be borne by him.

All Timber or Buildings which may be upon the Lands when taken possession of by the Contractor shall be accounted for by him to the Company.

The Lands required for the Permanent Works shall be given to the Contractor at such times as he shall be ready to commence the work upon them; and before commencing the work he shall fence them off.

MATERIALS AND WORKMANSHIP.

17. All Materials and Workmanship employed on this Contract shall be the best of their kind; and shall in all cases be subject to the approval of the Engineer; and shall be put to such reasonable tests as may be deemed necessary by him; but the fact of the Work having been certified for by the Engineer, or passed by his Inspector, is in nowise to be taken as a release to the Contractor from the obligation of maintenance as hereinbefore stated.

FENCING.

18. To consist of a Quickset Fence on each side of the line, and also of a Post and Rail Fence (or Seven Wire Fence).

The Quicks shall be healthy plants, three years old, set in a double row, 12 to the yard lineal, with proper mound and ditch. They shall be kept clean and properly trimmed, and where any die they shall be replaced.

The Post and Rail Fencing to consist of posts of oak or larch, 6 ft. 8 ins. long, and 7 ins. \times $3\frac{1}{2}$ ins., or of equal section at the smallest part, mortised with four holes to receive the rails, and placed 9 ft. apart, centre to centre, and 2 ft. 6 in. in the ground, and hooped at the top with $1\frac{1}{4}$ "hooping iron;" the rails to be of larch 4 in. \times 2 in. or of equal section at the smallest part passed through the post 3 in.; Prick Posts 5 ft. 6 in. \times 4 in. \times 2 in. to be driven into the ground midway between the posts, and firmly nailed to each rail.

One length of this Fencing to be put up for the Engineer's approval; before the rest is proceeded with.

The Wire Fencing (if used) shall consist of oak straining-posts, 8 ft. long, and 9 in. \times 9 in. diesquare, and wrought above ground and rough in the ground, placed 3 ft. 9 in. in the earth, and at an average distance of 220 yards apart, or nearer where openings in the Fence are required; and furnished with proper tightening rachets and struts. Ordinary posts are to be of round oak or larch, and not less than 5 in. diameter at the smallest girth; to be 7 ft. long, and 2 ft. 9 in. in the ground; to be firmly fixed 12 ft. apart, centre to centre, and to have seven wires, 0 gauge, strained along them and secured at each crossing with strong staples $1\frac{1}{2}$ in. long. A Prick Post of oak or larch 5 ft. 9 in. long, and 4 in. \times 2 in. in section is to be driven 2 ft. 9 in. into the ground, halfway between the ordinary posts, and fastened to the wires at each crossing, with staples; as shown on the Drawing.

EARTHWORK.

19. The Ground to be thoroughly cleared of all Timber and Fences.

All Cuttings and Embankments to be feet wide, at a level of inches below the upper surface of the rails, which level is to be called the Formation Level, and is shown red on the sections.

All Embankments to be formed with a slope of not less than $1\frac{1}{2}$ horizontal to 1 vertical; and all cuttings with a slope of not less than to 1; but in every case sufficient to prevent slipping.

All Embankments to be properly trimmed and soiled 6 inches deep, to the satisfaction of the Engineer; sufficient soil for the purpose, or turf where it exists, being taken off first of all from the site of the embankments. Where the slopes are not covered with turf, they shall be sown with rye grass and clover seed in the proportion of 3 lbs. of clover and 3 bushels of rye grass to the acre; and should these seeds fail they are to be re-sown.

Should the Cuttings not prove sufficient to provide materials for forming the Embankments, then excavation shall be made from the side at such points and in such form as the Engineer may direct; and should the Cuttings give more earth than is required, then the excess shall be run out, either to spoil or to the widening of the Embankments or Station Yards, or Road Approaches, in such manner as the Engineer may direct.

The Cuttings shall be effectively Drained by ditch or pipes.

Proper Culverts shall be inserted in the Embankments to allow for the necessary Drainage of the country.

The surface of all Road Approaches to have 9 inches of broken stone $2\frac{1}{2}$ inches square, and 3 inches of fine broken stone or gravel, as the Engineer may select; and the making and maintaining of the Highways

and Turnpike and Occupation Roads shall be to the satisfaction of the Surveyors or other authorities, and of the Occupiers for the time being.

All Earthwork shall, on completion, be carefully trimmed off, and neatly finished to the dimensions shown on the Sections.

Where the ground is boggy or wet, faggots and bushes shall be laid upon it before the Embankment is formed, to insure the stability of the line.

FOUNDATIONS.

20. The Foundations of Works are generally shown upon the Drawings, but the Contractor shall in all cases go to a greater or less depth if such be considered desirable by the Engineer; but such greater or less depth of Foundations shall not alter or vary the amount of the Contract Sum in any way.

BRICKWORK.

21. To be constructed with the best new, sound, and well-shapen hard-burnt bricks, and with mortar composed of one part of fresh well-burnt blue lias lime, of Greaves and Kershaw's make, or of other of equal quality, and approved by the Engineer, and three parts of clean sharp sand, to be mixed dry, and to be well tempered by being passed through a Pug Mill, with a proper quantity of water. The bricks to be well watered before being used.

No Brickwork to be carried on during frost. No joint shall be more than $\frac{1}{4}$ -in. thick, and outside joints to be neatly drawn and pointed where required by the Engineer.

All Brickwork shall be executed in the best style, and in English Bond.

Portland Cement shall be used instead of blue lias lime in the Arches, and in all places below water.

The Brickwork shall be backed up with dry earth as the work proceeds.

All Arches shall be covered with Asphalte one inch thick, laid in two layers.

The Price for the Brickwork is to include all necessary scaffolding, stagings, centres, and coffer-dams.

In all Battering Walls, whether curved or straight, the bed of the bricks shall be at right angles to the face of the external battering line.

STONWORK.

22. Where stone is used for Walls or Abutments, it shall be approved by the Engineer, in all cases Samples being submitted to him first of all. It shall be uniform in quality and colour, and the description of the work shall be that known as Coursed Rubble, with carefully hammer-picked beds and joints, laid in its natural bed, and well filled in and grouted with mortar as described for the Brickwork.

The String-Courses, Imposts, Quoins and Copings to be tool dressed.

Bramley Fall or York Stone to be used to receive the ends of all Girders, as bed-stones.

CONCRETE.

23. To consist of one part of blue lias lime, or other of equal and approved quality, and three parts of clean sharp sand, passed with a proper proportion of water through a Jury Mill or Pug Mill, and then thoroughly mixed with an equal quantity of clean gravel, so that the proportion of lime to sand and gravel shall be as one to six.

The Concrete shall be thrown into the Foundations from a height of not less than 6 feet immediately after mixing, and shall not be built upon till it has thoroughly set.

Where necessary, and in wet sites, the Engineer may require Portland Cement to be employed instead of blue lias lime.

TIMBER IN STRUCTURES.

24. All rough Timber Work shall be executed in the best style of rough ship's carpentry, that is, undressed in the main scantlings, but wrought true at all surfaces in contact; and all mortises, tenons, housings and scarfings and other joints shall be truly formed and fitted.

All Planking to be spiked with spikes twice as long as the planks are thick; two of them at each crossing, driven at a slight angle with each other and the vertical.

All Timber Structures to be thoroughly bolted, strapped and secured by wrought iron fastenings, and for such fastenings an allowance of 2 lbs. of iron is made to every cubic foot of timber (where the spans are not exceptional, or the height excessive, in which case more is allowed). The position and direction of the minor fastenings, where not shown upon the Drawings, to be determined by the Engineer.

All Wrought Timber to be executed in the best style of carpentry, and painted three times in oil of approved colour.

Where the Timber is shown upon the Drawings to be creosoted, 8 lbs. of creosote shall be forced under pressure into every cubic foot of dry timber.

Where the Timber is shown to be tarred, the Stockholm tar shall be used ; one coat being paid after erection, and another twelve months afterwards.

All Piles are to be shod with Wrought Iron Shoes, weighing not less than 2 lbs. to every inch in the size of the timber, and no ten inch pile shall be considered to be driven if it move $\frac{1}{2}$ inch with a blow from a 16 cwt. monkey falling 15 feet, and other sizes proportionately.

None but the best Baltic Red Timber, free from all defects, to be used ; except where Oak is shown, in which it shall be that of the best English growth.

CAST IRON.

25. To be clean sound Castings, free from sand, air holes, or cinder, to be run from a cupola. The Metal not to be inferior to that made by a mixture of $\frac{2}{3}$ of No. 2 hot blast grey pig mixed with $\frac{1}{3}$ of No. 3 cold blast, and capable of sustaining a tensile strain of not less than six tons per square inch without fracture, or a weight of 3,300 lbs. on the centre of a test bar 1 inch wide and 2 inches deep, with 3 feet clear span. Specimens of the iron to be submitted to the Engineer for approval whenever required.

All Patterns to be submitted when made to the inspection of the Engineer ; and all joints to be provided with proper chipping pieces, which are to be planed or chipped, and then caulked if required with iron cement, bolt holes to be provided with fillets and bosses.

The whole to be painted after inspection with three coats of approved oil paint ; the last coat to be put on when the work is fixed in place.

WROUGHT IRON.

26. Specimens of the Iron shall be submitted to the Engineer for approval, and the best quality shall in all cases be used ; the Plates being equal to the best Staffordshire (boiler) plates ; the Bar, Angle and T iron being not inferior to the best B B merchant bars ; and all bolts, rivets, nuts, straps and ties being wrought from iron not inferior to the best S C crown iron.

No Wrought Iron to sustain a less strain in tension lengthwise than 21 tons per square inch ; with an average elongation of one fifteenth of its length before rupture.

The whole of the Ironwork to be painted, after being passed on inspection by the Engineer, once in oils before leaving the works, and to have two coats of additional paint of approved colour when fixed.

NOTE.—This gives a very superior quality of material ; if the ordinary quality is required, instead of the word "*Boiler*" insert "*Bridge*," and instead of "21 tons and one fifteenth *elongation*" say "20 tons and one twentieth *elongation*." It is usual to give the higher tests for Bars, Angle and T Irons, and the lower ones for plates.

PUBLIC ROAD CROSSINGS.

27. In all cases of Public Roads crossed on the level, gates of good, sound, well-framed English oak are to be erected in accordance with the Drawings No. and in such manner that when opened for the Railway they shall entirely close the approach from the Road on each side ; and when closed to the Railway they shall form entirely across the same a secure and continuous Fence on both sides of the way across ; and must exhibit a disc of not less than 3 feet in diameter towards the line each way.

All the Gates to receive three coats of the best oil paint, of such colour as the Engineer may direct.

The Road to be paved with good approved stone between the rails and for four feet on each side of them ; and the remainder is to be metalled with approved stone or screened gravel 15 inches thick. Iron guard rails are to be fixed, so as to protect the rails of the line from passing traffic &c.

The Road across the Line must be kept smooth and free from water by drainage.

OCCUPATION ROAD CROSSINGS.

28. Fence Gates are to be provided and fixed by the Contractor wherever required by the Engineer. They are to consist of good sound English Oak, framed and put together in the best style of workmanship, and they are to be provided with proper fastenings, Wrought Iron hinges, chains and padlocks.

The Posts are to be of Oak, wrought die square and chamfered above ground and left rough below it ; and to be firmly fixed in the ground, and the Fence made good up to them.

These Gates are to receive three coats of good white oil paint, and are to have the words " Shut this Gate " legibly written on the top bar, on both sides of the Gates. They are to be 10 feet apart in the clear between the posts for a single crossing, and 12 feet in the clear for a double crossing, in which case there will be four gates to each crossing.

On Private Carriage Ways, when required by the Engineer, the Road is to be paved between the rails, and for 3 feet on each side of the same, with good approved stone ; and a board with the words " Penalty for not doing so 40s." is to be substituted for the chains and padlocks.

On all Occupation Crossings the Road is to be metalled across the whole width of the Line, from ditch to ditch, and for a breadth of 14 feet with approved metalling 9 inches thick.

No approach to be steeper than 1 in 16. Trunks of approved (creosoted) timber, in accordance with Drawing No. and of the same dimensions as marked on the Section, will have to be laid under the crossings on both sides of the Line to connect the ditches, and in case of Double Crossings, also from the boundary ditch into the side ditch.

LEVEL CROSSING LODGES.

29. To be erected at the points marked on the Plan, in accordance with the Drawings and Specifications thereunto annexed.

TELEGRAPH.

31. The Contractor is to provide, construct, and set up throughout the entire length of the Line, an Electric Telegraph with wires, and instruments at each of the Stations, complete and in full working order at the time the Line is opened for public traffic.

MILE AND GRADIENT POSTS.

32. Mile Posts are to be erected at every quarter of a mile, and Gradient Posts at every change of gradient, properly painted four times in oil, and written as directed.

PERMANENT WAY.

BALLAST.

33. To consist of clean gravel or broken stone, or other such material as the Engineer may approve, and the amount used shall not be less than cubic yards to the mile of single main line, and cubic yards to the mile for single line of siding.

The Ballast to be laid upon the Formation after it has thoroughly settled, and has been carefully sloped from the centre to the sides, so as to prevent lodgement of water; and it is to be feet wide at top and feet wide at bottom, and feet inches deep below the upper surface of the rails.

If Clay be used for the bottom ballast, it must be burnt in proper stacks or kilns, and it shall be covered in all cases with not less than inches of gravel or broken stone.

If Chalk be used for Bottom Ballast, it must be hard rock chalk only; not liable to disintegrate or decompose by the action of the weather.

Where Flints are found in the Cuttings, they shall be carefully collected from the tip head, and afterwards laid on the Formation in even layers, to form Bottom Ballast.

SLEEPERS.

34. The Sleepers to be of good Memel or Dantzic red fir [creosoted with not less than 8 lbs. of creosote to each cubic foot, under pressure, and the timber being thoroughly dry], and they shall be (for 4' 8½" gauge) 8 feet 11 inches long, 9 inches wide and 4½ inches deep; sawn rectangular; they shall be sound and free from sap, and No. shall be provided and laid to each mile of single line.

RAILS FOR A FIRST CLASS LINE A.

The Rails to be of the section shown upon the drawing, and to correspond exactly with a template to be submitted by the Contractor, and approved by the Engineer before manufacture.

The weight to be 80 lbs. per yard; any rail weighing less than 79 lbs. per yard will be rejected; and no allowance will be made for any weight exceeding 81 lbs. per yard; within these limits allowances to be made either way.

The lengths to be as follows:—

50 per cent., 24 feet long.
30 per cent., 21 feet long.
20 per cent., 18 feet long.

The Rails to be of uniform section throughout, to be sawn true and square at each end while hot, and if they require straightening, it must be done (without hammering) by pressure.

The Rails are to have two holes punched at each end for fishing; and holes in the bottom flange (if of Vignoles Section*) for fang bolts; the exact size and position of which are shown on the drawings.

Each Rail is to be marked, during rolling, with the name of the maker, the year of manufacture, and the letters "A & B Ry."

The Rails are to be subject to the inspection of the Engineer or his representative, who shall have every facility afforded him by the manufacturers for conducting his inspection. But notwithstanding such inspection at the Works, any Rails may be rejected on delivery which in the judgment of the Engineer are defective.

If within [] years from the time of opening for public traffic, the Rails laminate, crush, or split, or in any other way exhibit defects, they shall be replaced at the Contractor's own cost, and the decision of [] as to the defective Rails shall be final and binding.†

The Rails are to be of Beale's Parkgate make, or other of equal quality to be approved by the Engineer; and made under a five ton hammer, of clay mine iron, free from admixture of Cleveland or Northampton

* If not, then cast iron chairs; wood keys and twisted spikes, or trenail and spike, must be specified.

† If this maintenance clause is not adopted, a test should be inserted instead.

Ores. The Piles are to be of Puddled Bars not less than 12 inches \times 10 inches, the top slab being of hammered iron the whole width of the pile and 2 inches thick: this large pile to be hammered into a bloom, 8 inches \times 6 inches, and again heated and rolled into a Rail, making the whole equal to No. 3 Iron.

FISHES (FOR A FIRST CLASS LINE).

The Fish-plates shall weigh not more than 25 lbs. per pair, nor less than 23 lbs., and are to be in accordance with the drawings hereunto annexed, and are to be accurately rolled to fit the contour of the Rail at the points of contact.

The iron shall be of the same quality as that forming the top slab of the Rail.

The length shall be 15 inches; the ends being cut clean and square.

Each outside Plate shall have four $\frac{1}{4}$ square holes punched in it, and each inside one four $\frac{1}{4}$ round holes, according to the drawing, care being taken to have the edges of the holes clean and free from roughness or cracks.

BOLTS (FOR A FIRST CLASS LINE).

Four Fish-bolts are required to each pair of Fish-plates; each to be $\frac{7}{8}$ inch diameter, and forged out of best Staffordshire or fibrous iron, the heads being formed out of the solid and round; underneath the head the bolt stem shall be $\frac{7}{8}$ inch square for half an inch, to prevent turning when the nut is being screwed up.

A Whitworth Thread is to be used for $1\frac{3}{4}$ inches along the length of the bolt: and on it shall be screwed a hexagon nut, the length and general dimensions being given on the drawing.

To every Nut, one Grover's Steel Spring Washer shall be provided, of not less weight than one ounce, to prevent it from working loose.

The Fang-bolts (if the Vignoles Section of Rails be used) to be $\frac{3}{4}$ inches diameter, of the same quality of iron as the Fish-bolts, four to each sleeper; Fang-nuts to be provided for each Bolt as shown on the drawing.

The Contractor will not be allowed to use the Permanent Way Materials for making the Railway, without the written permission of the Engineer.

RAILS AND FASTENINGS FOR A SECOND CLASS LINE . . . B.

RAILS.

Are to be of the section shown on the drawing of Permanent Way, a template of which shall be supplied to the Contractor, and to this template the finished Rail must correspond.

The Rail shall weigh not more than 61 lbs. to the yard, and not less than 59 lbs., the weight required being 60 lbs.

Not less than 80 per cent. shall be in lengths of 23 feet, and the remaining 20 per cent. may vary from 18 feet to 20 feet lengths; they are not to be specially rolled, but are to be cut from larger ones which may be defective at the ends.

Wherever special lengths (not exceeding 23 feet long) are required, they are to be supplied according to a list, which will be from time to time given.

The Piles from which the Rails are to be rolled shall be 9 inches wide by 9 inches deep, and shall consist of a slab of No. 2 Iron at the top, 2 inches thick, and of the whole width of the Pile; and the remainder of puddled bars, $\frac{3}{4}$ inch thick properly breaking joint. The bars in a Pile must extend throughout its whole length.

The Rail-pile is to be rolled and hammered at a welding heat into a solid bloom 5 inches wide and 5 inches deep, which is again to be raised to a welding heat and rolled into the Rail.

All Rails shall be sawn clean and square at the ends, and shall be free from defects of any kind; if they are straightened, it shall be by pressure and not by hammering.

Each Rail shall be stamped with the Maker's name or initials, the year of manufacture, and the letters "A. & B. Ry."

Each Rail will require to have two holes punched at each end for Fishing-bolts; the position and dimensions of which are shown on the detailed drawings.

Holes are also to be punched in the flange of each Rail (if of Vignoles Section) $\frac{1}{16}$ inch in diameter, to receive the $\frac{1}{16}$ inch Fang-bolts and Screws for securing them to the Sleepers. The exact position of the Bolt-holes is shown on the drawings. (See Note below.)

FISH-PLATES.

The Fish-plates are to be of the section shown on the Drawing, and in accordance with a template to be furnished by the Engineer. They are to be 14 inches long, and to be sawn off square and not shorn; they are to be straight, smooth and uniform.

Each Fish-plate is to have four holes punched or drilled in it, $\frac{1}{16}$ inches square in the outside plates, and $\frac{1}{16}$ inches in diameter in the inside ones, and at the distances shown on the Drawings.

Each Plate shall be stamped with the Makers' name or initials, and the year of manufacture. Specimens of the Fish-plates to be submitted for approval.

FANG-BOLTS, WOOD-SCREWS, & FISH-BOLTS,

are to be in accordance with the Drawings, and made of the best Staffordshire iron, or of other of equal and approved quality, specimens being submitted to the Engineer for his approval in each case in the first instance.

The heads of both Bolts and Screws shall be forged out of the solid and not welded on; the Nuts of the Fang-bolts shall be turned up, as shown, to hold in the Sleeper.

The Fish-bolts are to be formed of $\frac{7}{8}$ inch iron; the heads are to be round and the nuts are to be square, and to fit without shake upon the bolts. Whitworth Threads are to be used for approval.

Each Nut for Fish-bolts shall be accompanied by one Grover's Steel Washer, of not less than one ounce weight, to prevent its working loose.

The whole of the Fastenings are to be immersed whilst hot in boiled Linseed Oil, and packed in strong bags, of not more than 5 cwt. each, for delivery.

A complete Rail-joint on pieces of wood representing the Sleepers, with Fish-plates and Fastenings complete as contracted for, is to be provided by the Contractor for the Engineer, whose written approval of the sample must be given before the work proceeds.

POINTS AND CROSSINGS

will have to be provided, in number [] laid in such positions as will be directed, and of requisite angles; the tongues of the switches to be 12 feet long, and to be made from rails of similar section to those otherwise used on the line. The Crossings to be of Steel or hardened Iron.

INSPECTION, &c.

The Engineer shall have power to inspect the manufacture of the Rails, Fish-plates and Fastenings, and Points and Crossings, and shall have full power to reject any materials or workmanship of which he may disapprove, either at the works or on delivery.

The Contractor may use the Rails and Fastenings of the Permanent Way for carrying out the Works, but only under such circumstances and with such wagons as the Engineer may approve; and on the condition that any rail which may be nicked or worn in the process shall be rejected, and that any that are bent shall be made straight.

The Contractor must not use the Permanent Sleepers for the Temporary Works, except when Ballasting with an Engine.

NOTE.—A clause to maintain for a certain number of years may be arranged to price; in its absence, a test should be stated; this varies with the Section. Generally a 60 lbs. Vignoles Flanch rail, with a 3' 6" bearing, will take a blow from a 6 cwt. monkey falling 12 feet, without deflecting more than one inch, or giving $\frac{1}{8}$ inch permanent set.

RAILS AND FASTENINGS FOR A THIRD CLASS LINE C.

RAILS.

The Rails are to be of the Vignoles Section shewn on the Drawing, and according to the template and gauges to be provided by the Engineer.

The weight of the Rails must be as near as possible 40 lbs per yard, and no Rail shall be received weighing less than $39\frac{1}{2}$ lbs. per yard; nor will any allowance be made for any Rail weighing more than $40\frac{1}{2}$ lbs. per yard.

They are to be perfectly true and straight, and of uniform Section throughout; the ends being sawn off square.

Each Rail to have four oblong holes punched in it $\frac{3}{4}$ in. by 1 in., in the position shown upon the Drawing.

Each Rail to have the Maker's name and the year of manufacture stamped upon it.

The Rails are to be manufactured as follows :—

Each Rail is to be made from a pile 8 inches wide and 9 inches deep, consisting of one bar of iron $1\frac{1}{2}$ inches thick at the top, and of intermediate bars not exceeding 1 inch in thickness, and of such width as to break the joints. This pile is to be rolled out at a welding heat, and after being again raised to a welding heat is to be rolled into the Rail.

The Bar forming the top slab is to be manufactured from such a mixture of mine iron ores as shall be approved by the Engineer, and shall produce the closest and hardest wrought iron, and shall be formed from the puddle ball under a hammer, which shall be equal to a five ton tilt hammer.

The central part of the pile shall be built up of bars not exceeding one inch in thickness, which are to be of such a mixture of mine iron as shall produce a tough and close wrought iron, and shall be formed from the puddle ball, under a five ton tilt hammer, into a slab of convenient form, which shall be re-heated sufficiently for its reduction into bars of the required thickness not exceeding 1 inch.

(In the event of the Contractors guaranteeing the Rails for a certain time, it is not necessary to specify the tests, as such guarantee is sufficient; but without it a test clause is necessary.)

The Engineer shall test samples from the Rails at various times with a weight of 16 tons on the centre of a span of 3 feet 0 inches, and no Rail will be accepted which deflects with this weight more than $\frac{3}{4}$ of an inch, and all shall carry a maximum central weight of 24 tons without breaking.*

All the Rails must be free from splits, cracks, or laminations, and in all respects sound and straight.

The Rails are to be of the following lengths:—

[]	per cent.,	[]	feet long.
[]	per cent.,	[]	feet long.
[]	per cent.,	[]	feet long.

And each Rail is to be provided with two holes at each end, of the size and position shown upon the Drawing for the Fish-Bolts.

Certain samples of the Rails shall be tested by a falling weight of 700 lbs. from a height of 5 feet; the bearing being 2 feet 6 inches, and no Rail will be passed which shall deflect under this blow more than $1\frac{1}{2}$ inches, or which breaks if the weight be dropped upon it from a height of 16 feet.

For a 30 lbs Vignoles average Section Rail suitable for a steam tram road the following tests are sufficient :—

No. 1. Bearing 3 feet apart. Dead load in centre, 5 tons. Deflection after half an hour not to exceed half an inch; and the permanent set not to exceed $\frac{1}{8}$ of an inch.

No. 2. Bearing 3 feet apart. Falling weight 500 lbs.; fall 4 feet. Rail to be capable of bearing two blows without deflecting more than one inch and without breaking.

* This test of course depends upon the form of the Section.

SPECIFICATION FOR BOLTS.

The Bolts are to be made of the best S. C. Crown Iron, and are to be manufactured out of 1 inch diameter iron : the heads to be square and to be worked out of the solid and not welded on. The bolts are to be $\frac{7}{8}$ inch diameter, and [] inches long, with a head $1\frac{1}{2}$ inch square and $\frac{7}{8}$ inch thick; the stem of the bolt under the head for half an inch in length to be $\frac{7}{8}$ inch square. They are to be screwed for a length of $1\frac{3}{4}$ inches with a strong uniform Whitworth thread, eight threads to an inch. Every bolt must have the threads full up. Square nuts of the same size as the bolt heads must be provided, one to each bolt ; and must be made to screw upon the bolt without shake, but not so tightly that they cannot be screwed by hand.

Samples of the above must be submitted to the Engineer for his approval before the rest are proceeded with.

The number of bolts required is [] and the weight of them is to be [].

As soon as the Contractor is prepared to begin the manufacture of the bolts, an Inspector will be appointed by the Engineer to gauge and test them, who will have full power to reject all such as are defective, or which do not comply with the Specification or Drawings.

The whole of the Bolts are to be dipped in hot boiled Linseed Oil before they have been exposed to the weather, as a protection against rust; they are then to be packed in bags of convenient size for carriage.

The whole of the bolts are to be delivered within [] months from the date of the acceptance of the Tender, and the deliveries are to commence within two months from that date, a [] part of the entire quantity to be delivered every month from that date.

Each nut shall be provided with one Grover's Steel Spring Washer to prevent its working loose.

Spikes of the form shown upon the Drawing shall be provided. They are to be made of the best S. C. Crown Iron, and to weigh each oz.

HEADS OF REQUIREMENTS FOR JUNCTIONS, STATIONS AND FITTINGS.

JUNCTION AT [] STATION.

A length of the Permanent Way for joining up to the existing Line (viz., the Main Line which the A and B Railway is supposed to join) will have to be laid of a similar description to that used on the existing Line, and to the satisfaction of that Company's Engineer ; but should that Company elect to do the work themselves, they will be allowed to do so, the amount set down for the Junction Works being deducted from this Contract.

The various Works at the Junction are to be executed as detailed in a List (hereunto appended), and in accordance with Drawings Nos. [], but so far as quality and supervision, and all other conditions are concerned, the general specification is to apply.

The Earthwork is included in the general Quantities.

The Sidings are included in the Permanent Way.

No. [] sets of Switches and Crossings.

No. [] Station Signals, with Semaphore Arms, 25 feet high above ground, with ladder, lamps, and necessary fittings complete.

No. [] Distant Signals, with Semaphore Arms, 15 feet high above ground, with ladders, lamps and complete fittings.

No. [] yards of 7-strand galvanized wire, with necessary wood posts and pullies, cranks, etc. and No. [] patent compensating pull-over levers, the whole fixed complete.

No. [] Chock Blocks.

NOTE.—The Company with whose Line the junction is to be made will probably send in a list of their requirements as to working the Traffic from signal boxes with locking-gear and lever-rods etc.

REQUIREMENTS AT [] STATION.

Earthworks and Fencing included in the general Quantities.

Sidings included in the Permanent Way, and are measured to include the lengths of switches and crossings.

No. [] Station Buildings, according to Drawings Nos. [] and detailed specification with same.

Platform [] feet long, by [] feet wide, with ramps at each end, gravelling six inches thick, palisading as specified, with board with name of station. The walls of the platform to be [] feet high above the rails, to be 14 inches thick, and coped with best blue coping bricks, one foot thick.

Water Supply, consisting of tank house with wall (or standard) water crane ; tank of cast (or wrought) iron, to hold [] gallons, with water gauges, double action pump [] ins. stroke, and [] ins. diameter of plunger, with proper connections complete, as shown on the Drawings ; well [] feet diameter and [] yards deep ; 2 inch socket pipes from tank to booking office ; a cistern to same, etc.

Good Warehouse, as by Drawing and special specification.

Road Weigh Bridge.

One Road Weighing Machine, platform, 12 ft. × 7 ft. to weigh 12 tons, with office, &c., as per drawing.

Railway Weigh Bridge [] feet long, to weigh up to 15 tons, fixed complete, with all necessary foundations, connections, &c., from machine to office.

Carriage Wharf and Dock.

Cattle and Sheep Pens.

Five Ton Wharf Crane.

Turntables, No. [] [] feet diameter &c. with their foundations, walls, stops, &c.

Pumping Engine [] H. P. to lift [] gallons per hour [] feet high. Boiler House with chimney [] yards high ; Boilers with fittings, &c.

Engine House of galvanized iron, as by Drawing No. []. Ash pit 20 feet long by 3 feet deep, with brickwork walls and grating for drain. Paving of house with bricks on edge.

Coal Stage of Timber (14' 6") feet by (7' 6") feet.

In Station Yard :—

Metalling, [] square yards, [] inches deep.

Entrance Gates, No. [] pairs.

Switches and Crossings, No. [] sets.

Waggon Height Gauges, with bell No. []

Siding or Station Stops, No. []

Chock Blocks, No. []

Semaphore Station Signals, No. []

Semaphore Distance Signals, No. []

No. [] yards run of 7-strand galvanized wire with necessary wood posts and pullies, cranks &c. and No. [] patent compensating pull-over levers.

Paving, with dry stone or brick on edge as follows []

Drain Pipes and Cesspools.

Gas Fittings [] yards Cast Iron Main with [] yards of branches, junctions, connections for supplying Gas to the booking office and waiting rooms and other buildings.

No. [] external lights.

No. [] internal lights.

No. [] Cast Iron Lamp-posts, [] feet high with glazed lamps and reflectors, having name of station on the glass.

All burners, brackets, arms, cocks, meters, &c. as required complete.

STATION BUILDINGS,

As by Drawings Nos. [] and the Specification.

NOTE.—It is usual in country railways, where the station buildings form an inconsiderable item of the whole cost, to supply drawings of the buildings required, and to measure up the work as it is done; paying the Contractor on a certain Schedule as may be agreed upon, taken for instance from Laxton's Price Book for the current year, or with a modification thereof of [] per cent. as an agreed general deduction or addition.

Where the Stations are large and important, of course special quantities and surveys must be supplied for tendering upon, as with the rest of the work

A general List of the actual works, with the numbers of the Drawings referring to each, may also be given, commencing at one end of the Line and continuing through the whole route.

TENDER.

TO THE DIRECTORS OF THE **A.** AND **B.** RAILWAY.

GENTLEMEN,—

I hereby offer to construct and complete within months, this Railway, in accordance with the plans and specification, to the entire satisfaction of your Engineer, and on land to be given by you. And I undertake also to do all contingent and incidental works which may be necessary in carrying out the undertaking, and handing it over ready for traffic (station buildings alone excepted), and I undertake all maintenance and other obligations and responsibilities imposed in the foregoing specification

for the sum of pounds shillings and pence (£ s. d.)

to be paid to me in cash in the manner therein described.

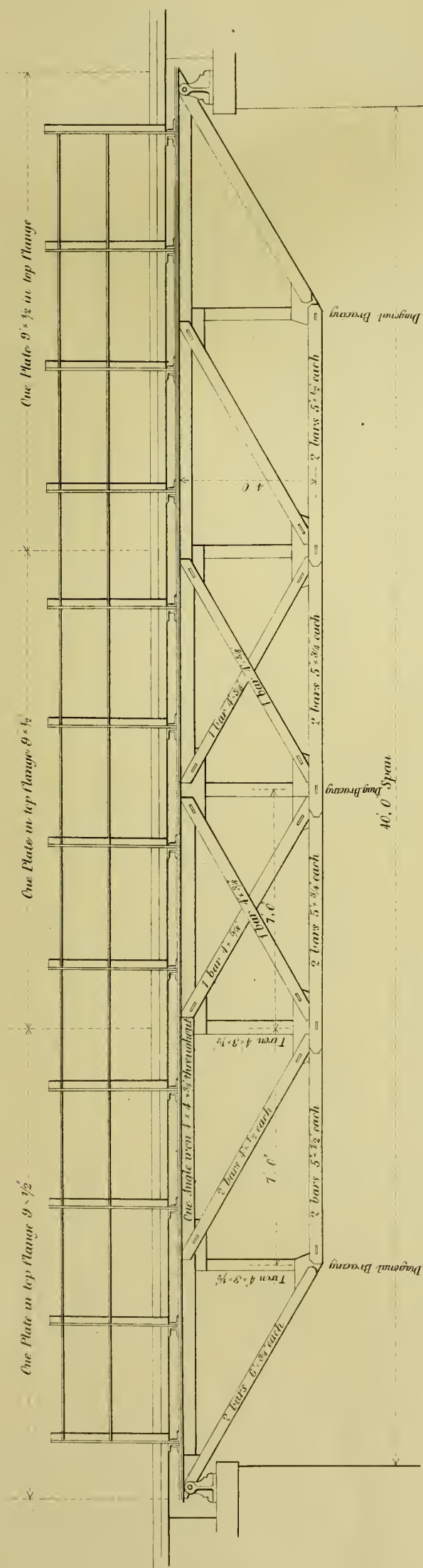
And I agree to execute a formal deed of contract to this effect when called upon by you to do so.

I am, Gentlemen,

Your obedient servant,

Dated this day of 18 .

DIAGRAM.



Scale, 4 feet to one inch.

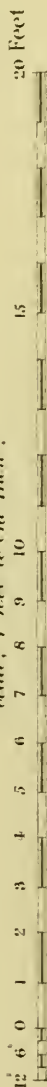
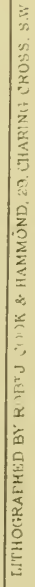
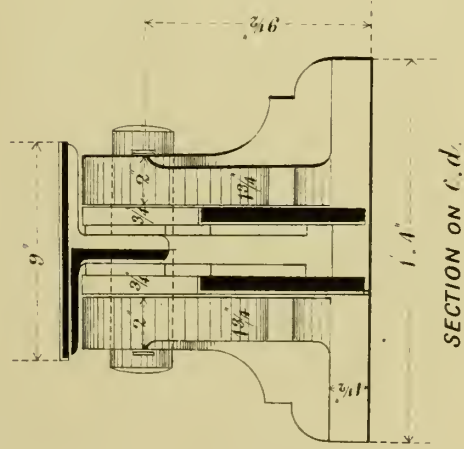
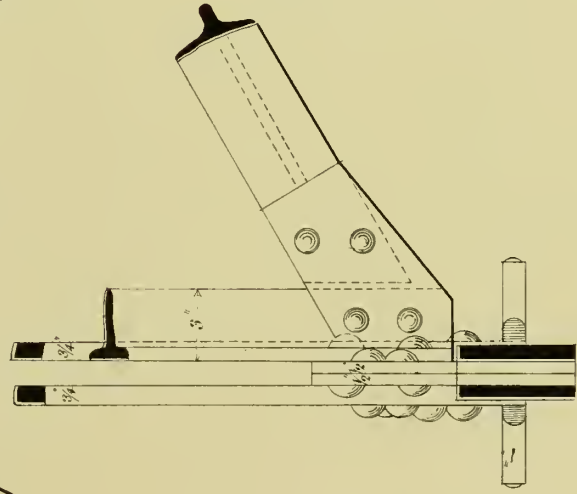
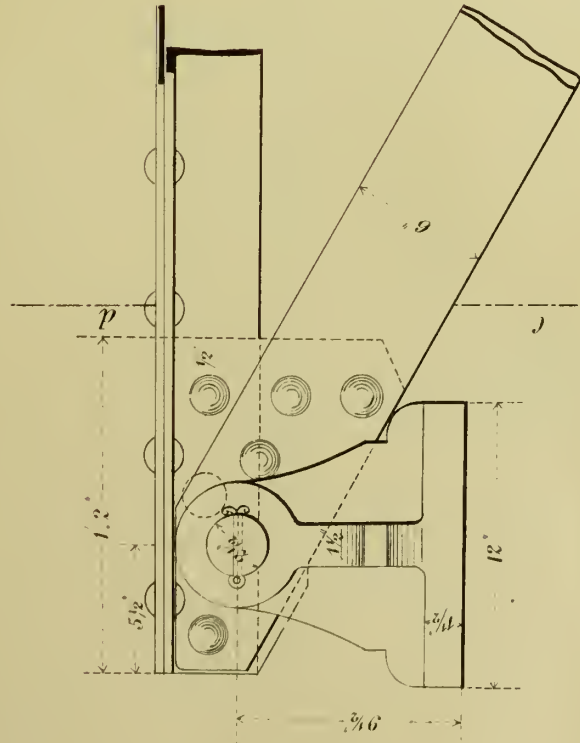
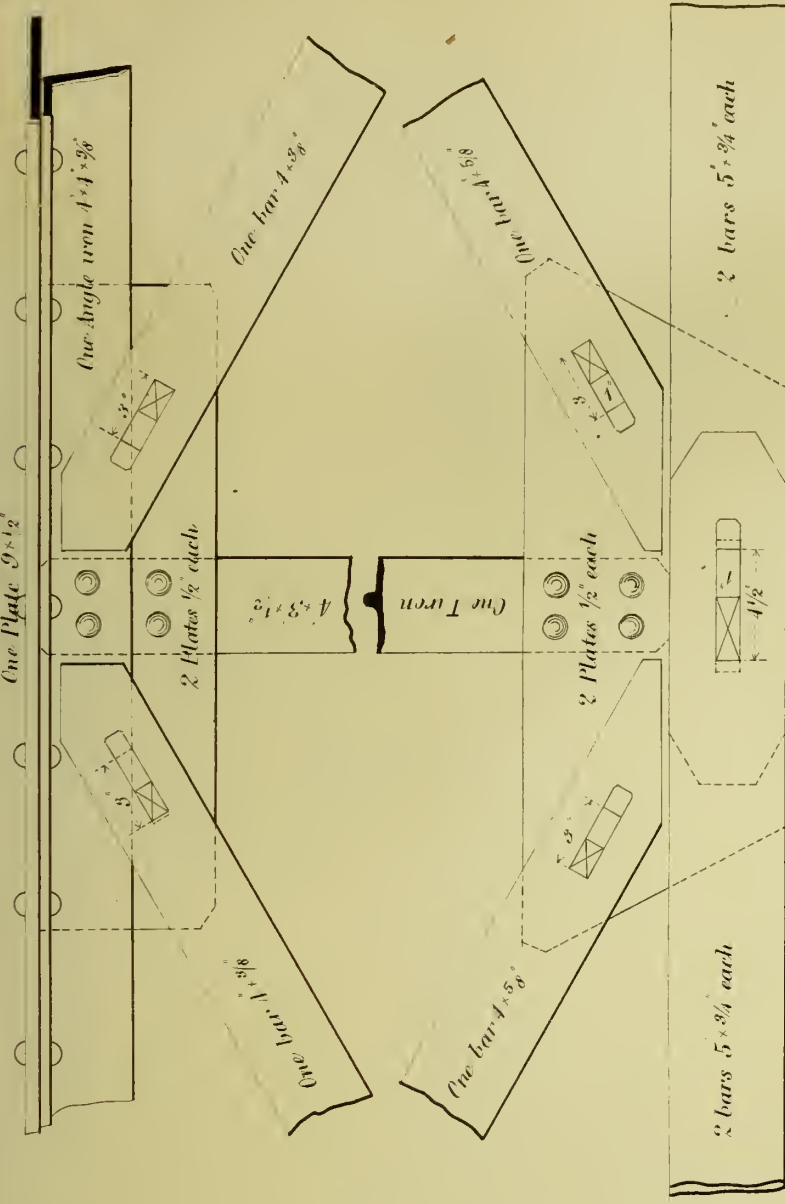


PLATE 2.

DETAILS.

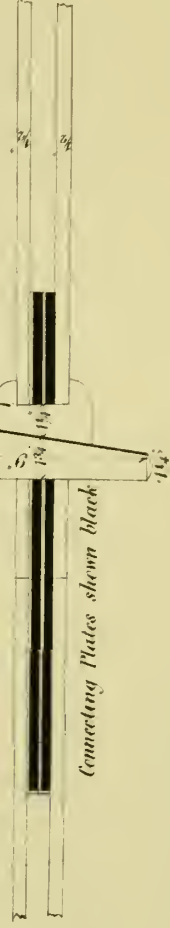




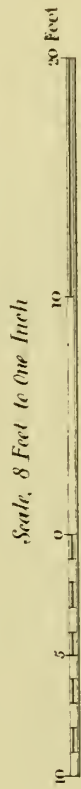
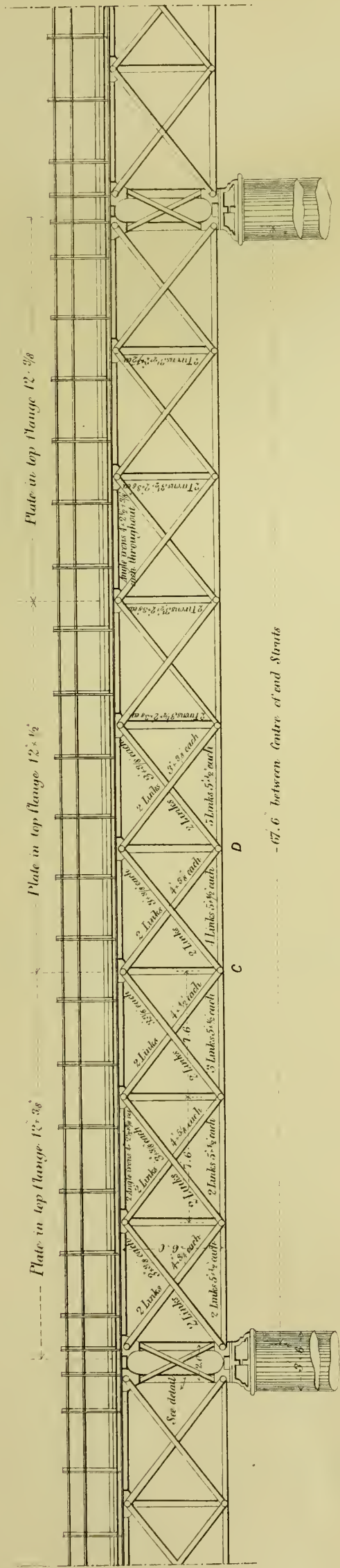
SECTION ON g. h.

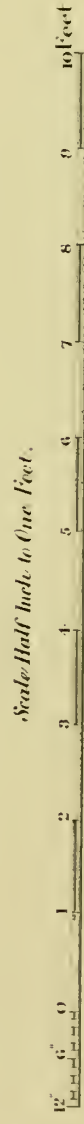
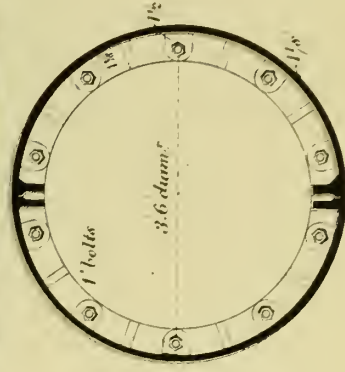
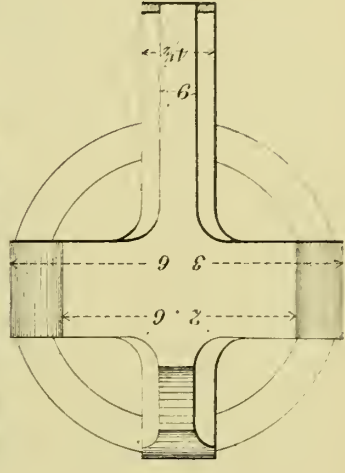
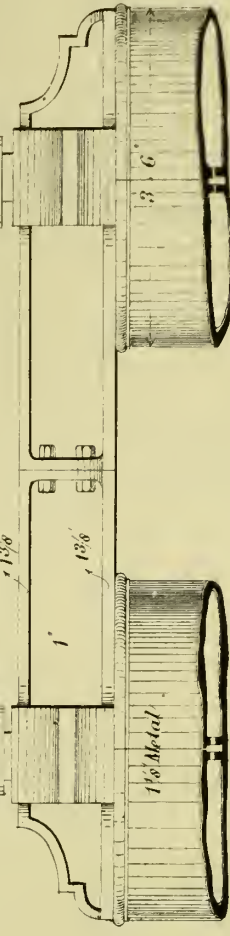
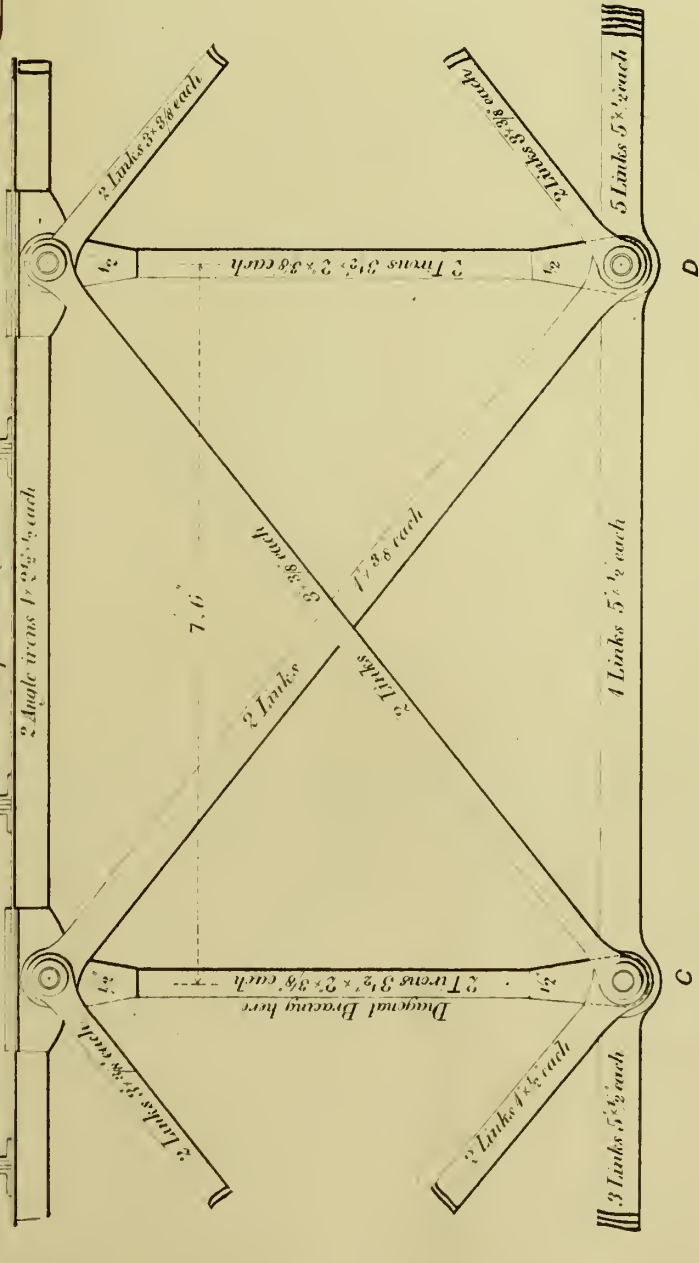
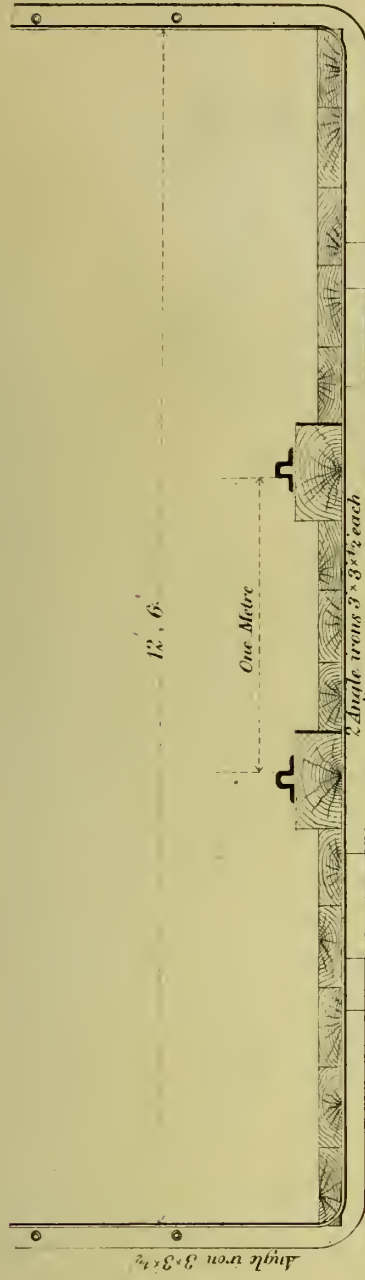
SECTION ON c. d.

Scale $1 \frac{1}{2}$ inches to One Foot.

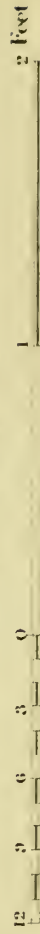
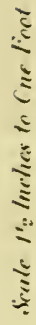


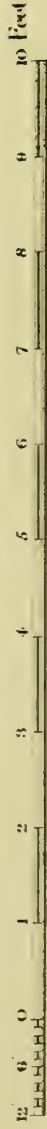
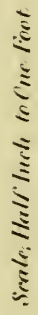
METRE GAUGE. 67 F^t., 6 Iⁿ SPAN.
DIAGRAM.





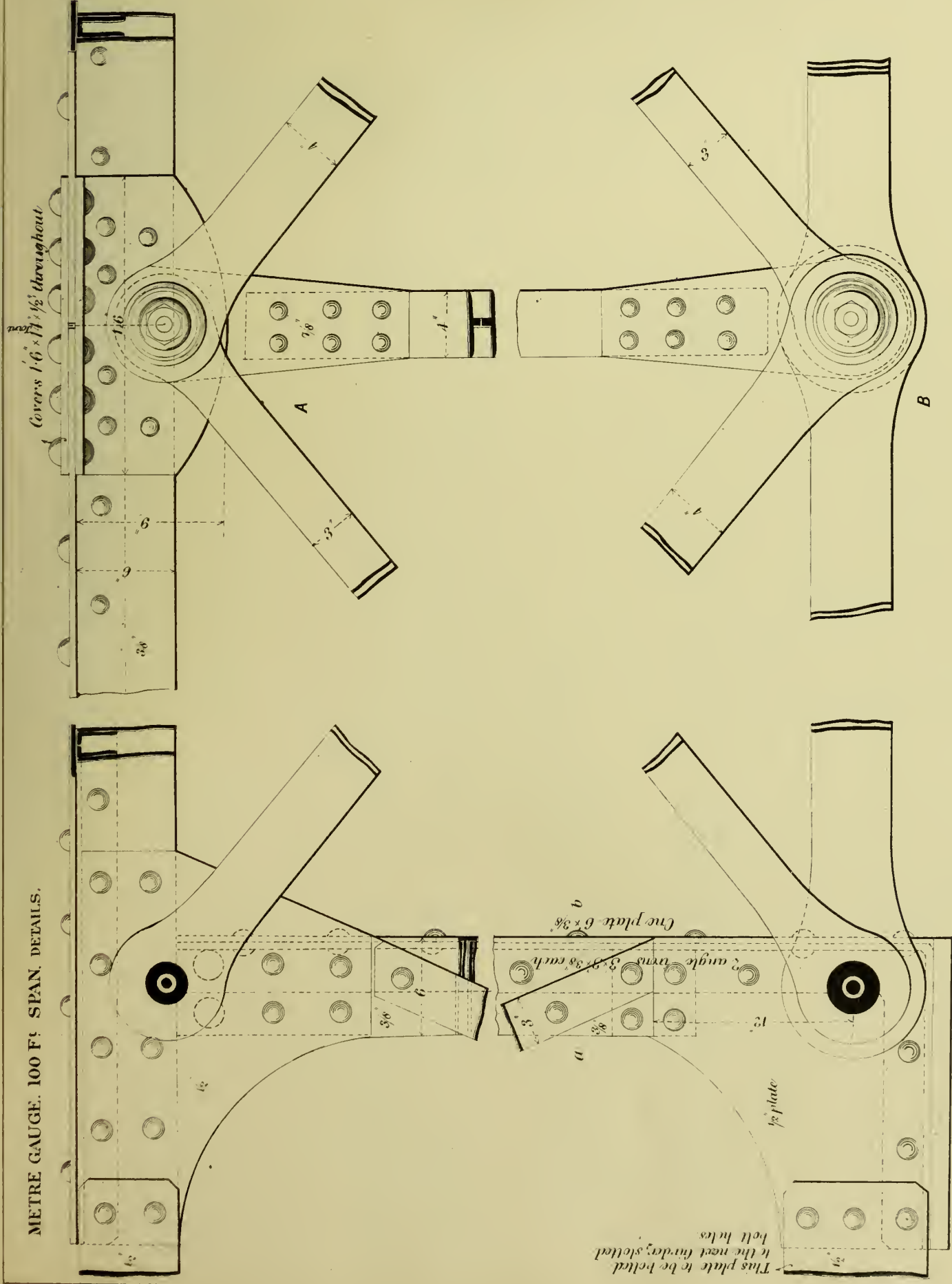
n



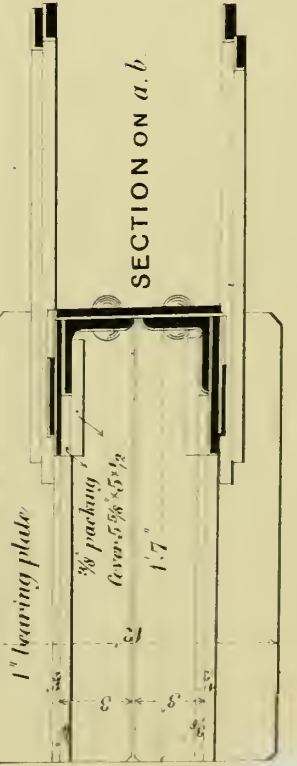


METRE GAUGE. 100 F. SPAN. DETAILS.

PLATE 9.

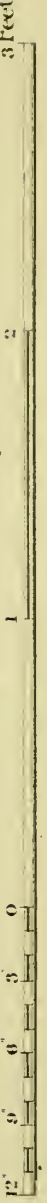



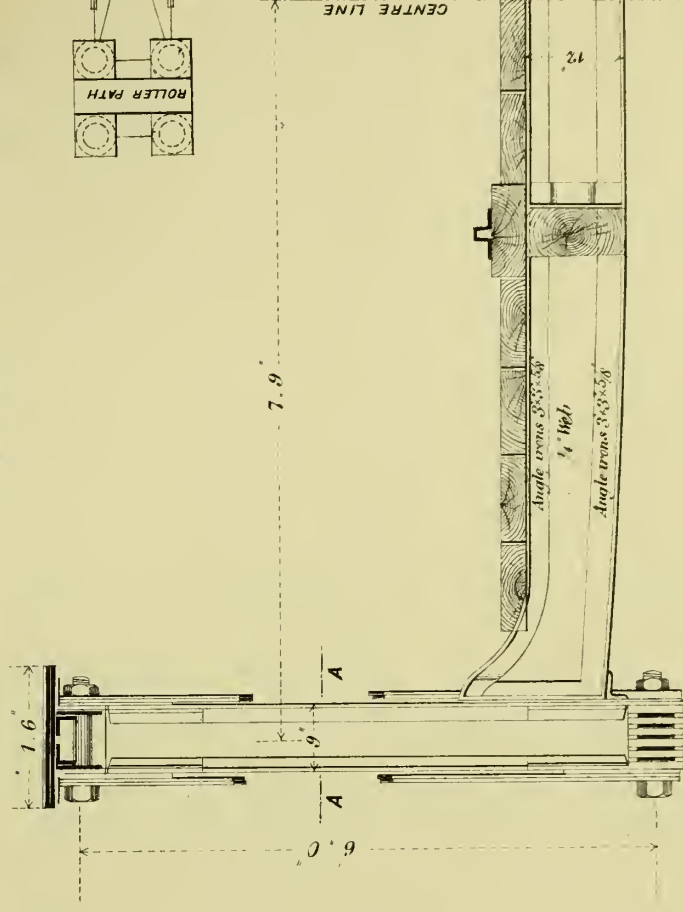
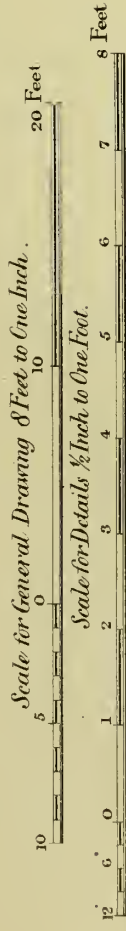
Rivets countersunk on under side



SECTION ON a-b

Scale, 1/2 inches to one foot.

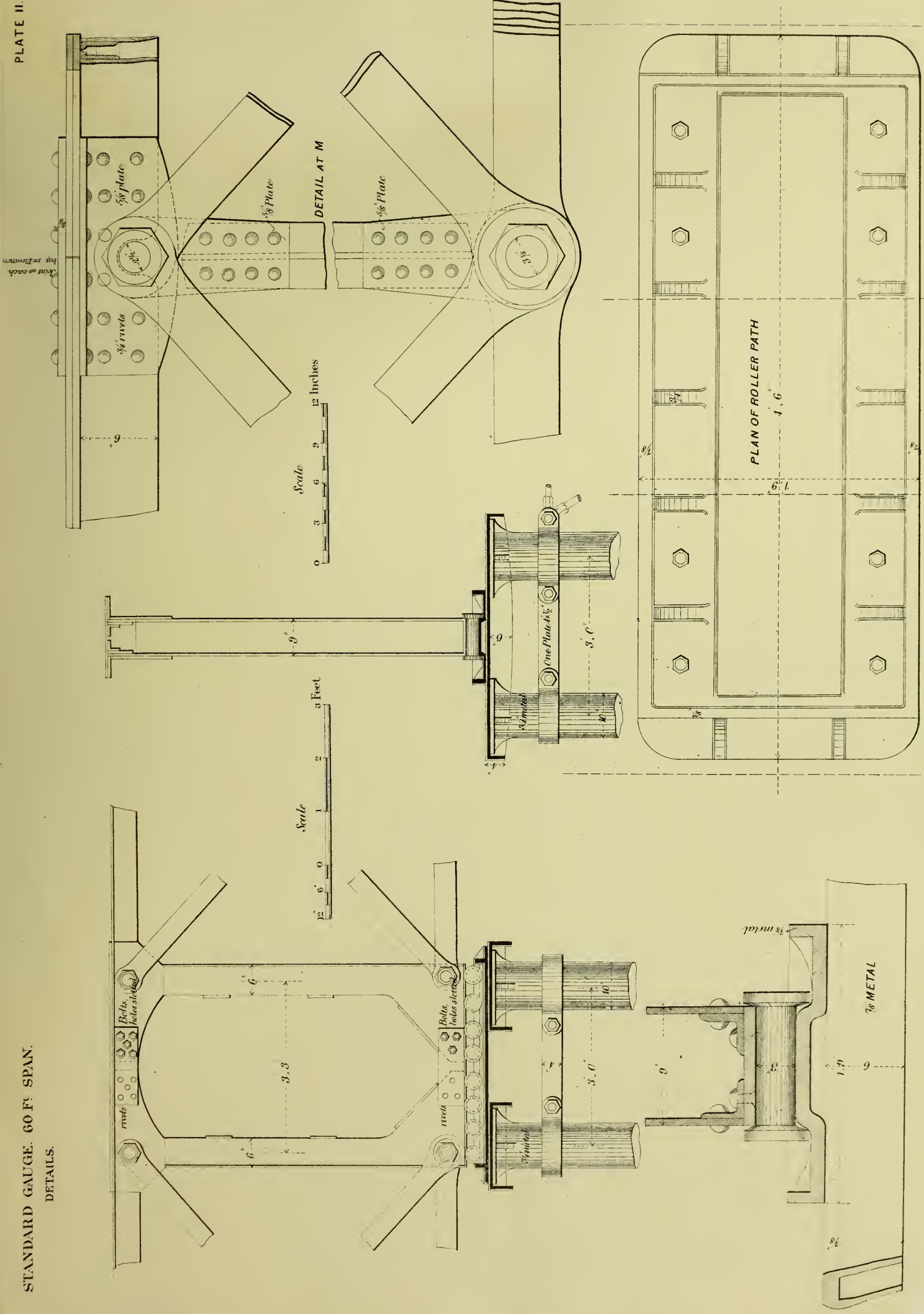


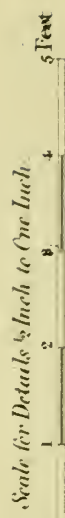


Angle varies in
Web varies in
different struts

SECTION ON AA

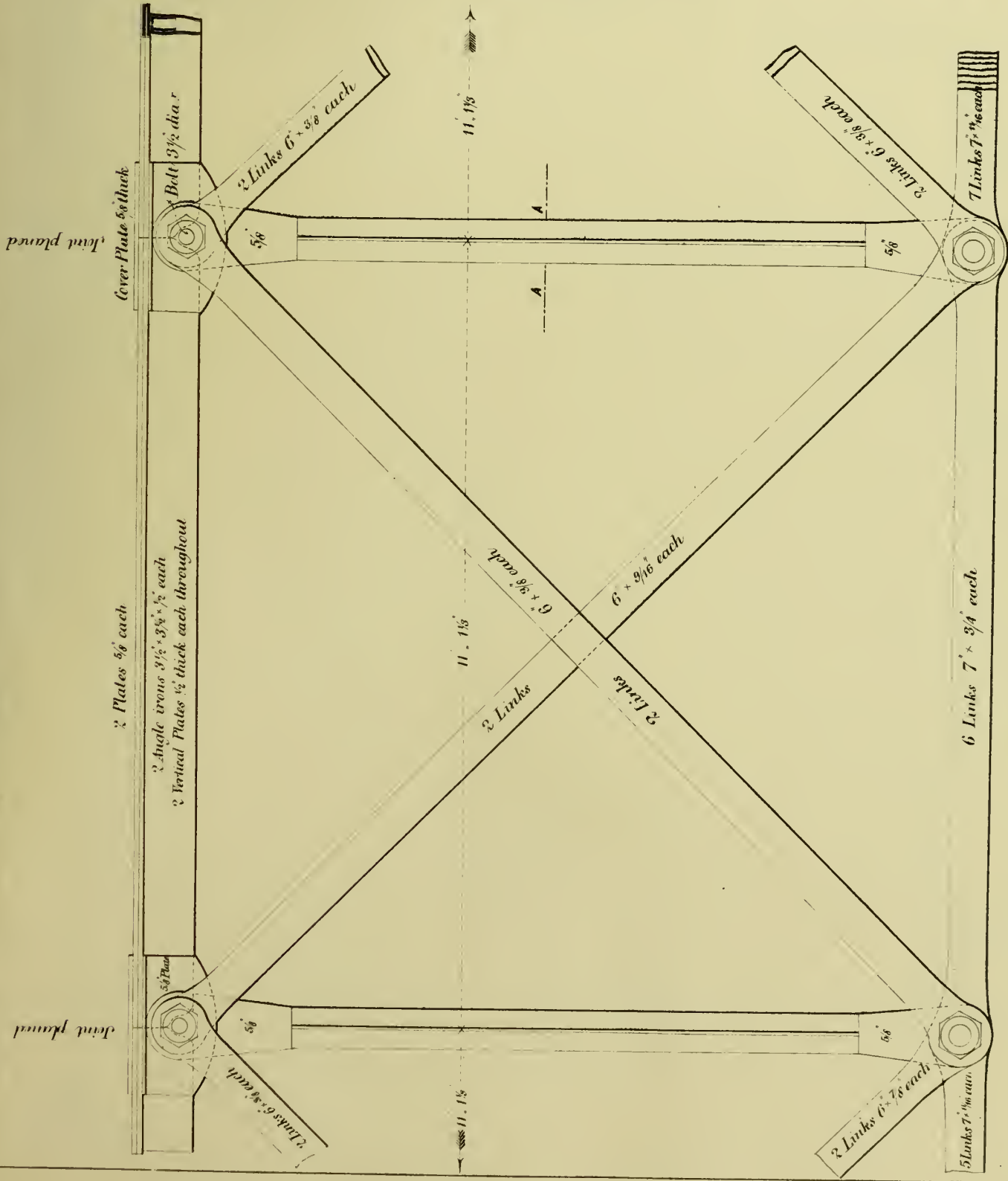
STANDARD GAUGE. 60 FT. SPAN.
DETAILS.



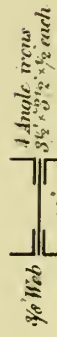


LITHOGRAPHED BY ROBT J COOK & HAMMOND, 29 CHAPING CROSS, S.W

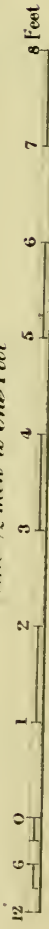




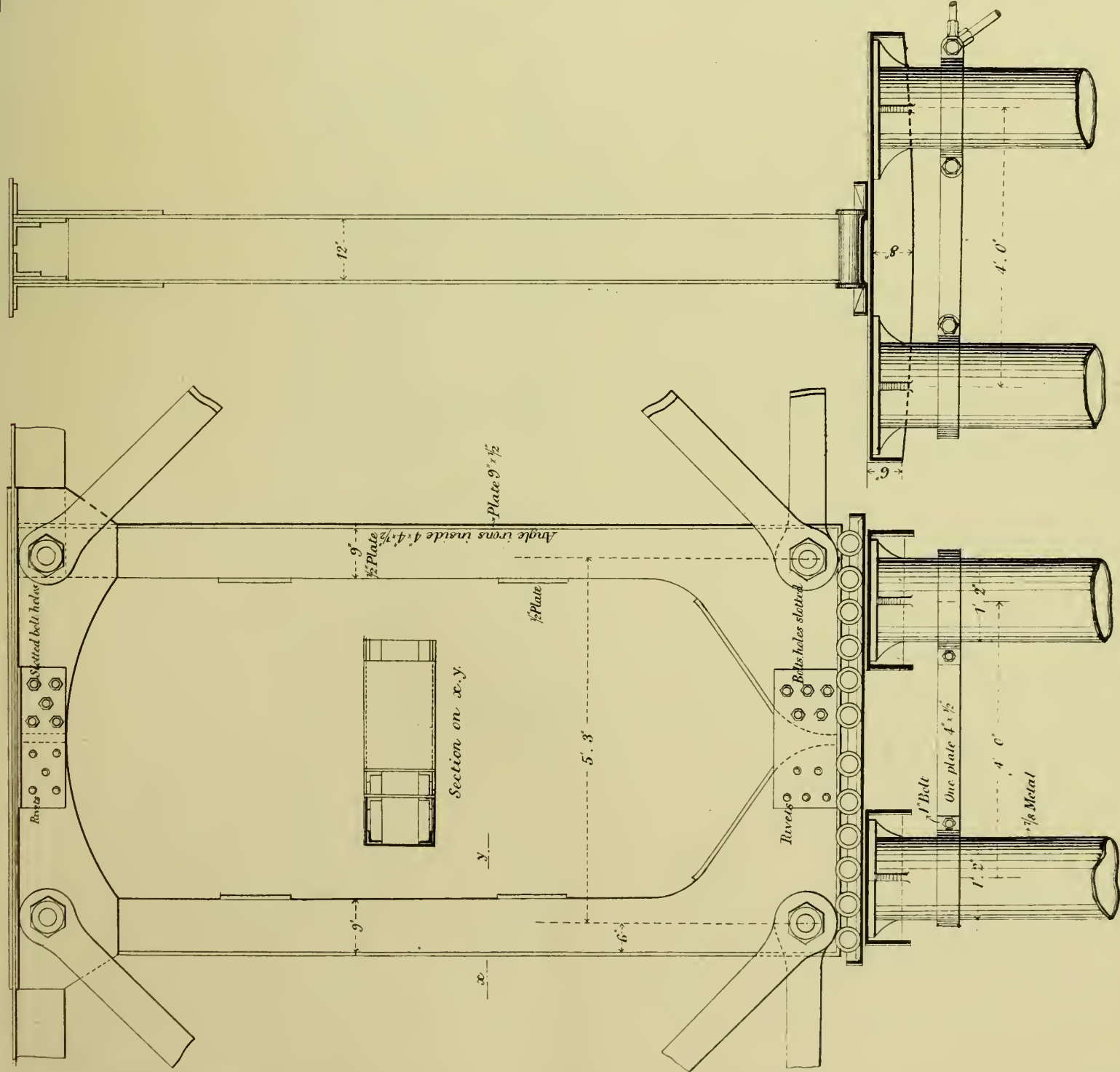
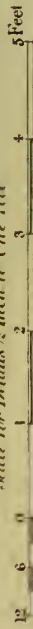
BAY L.M. ENLARGED



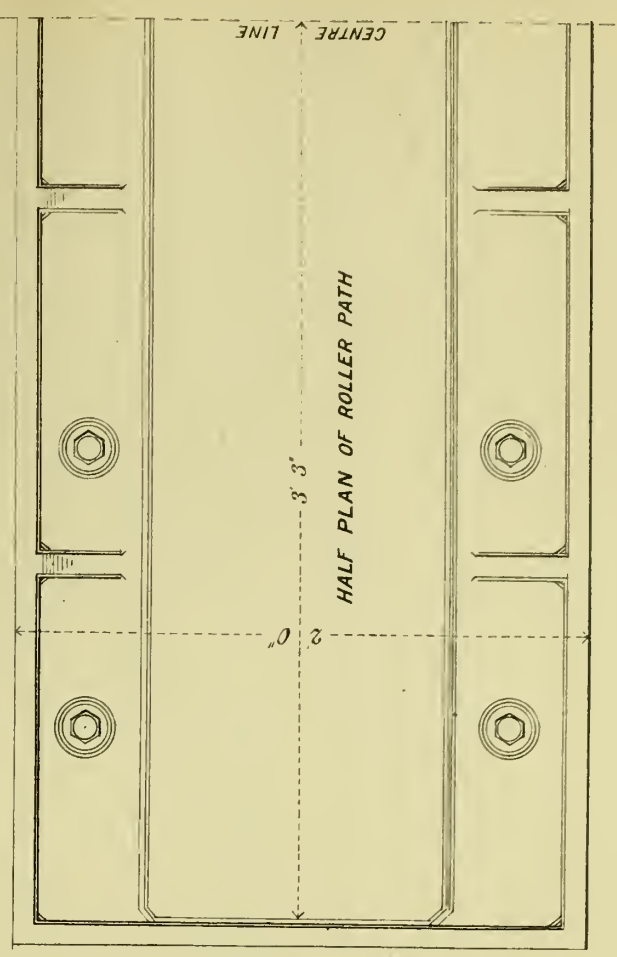
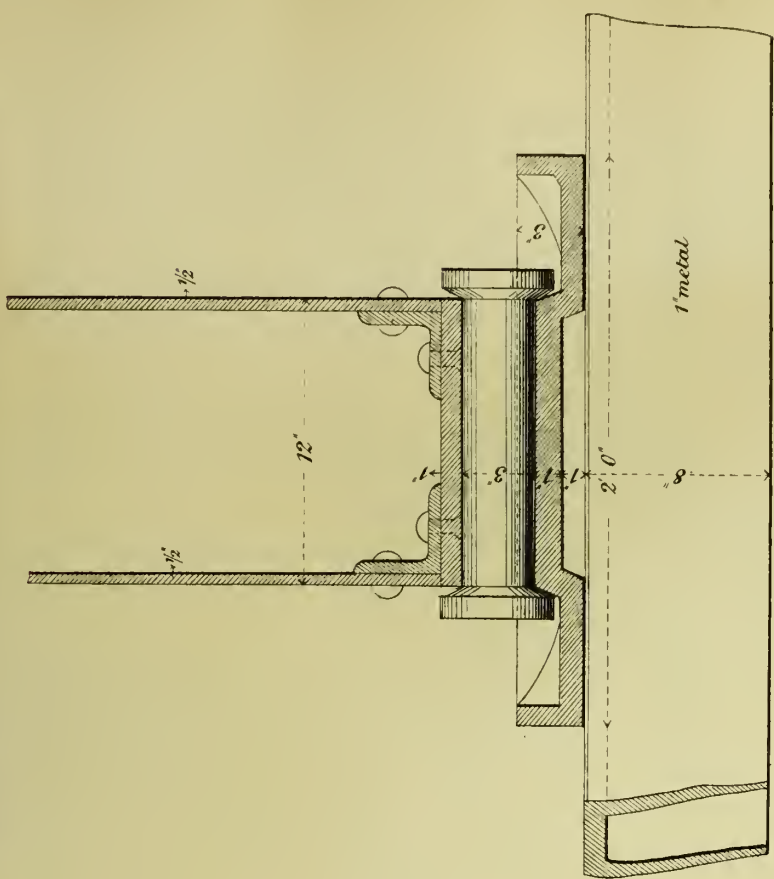
Scale 1/2" Inch to One Foot



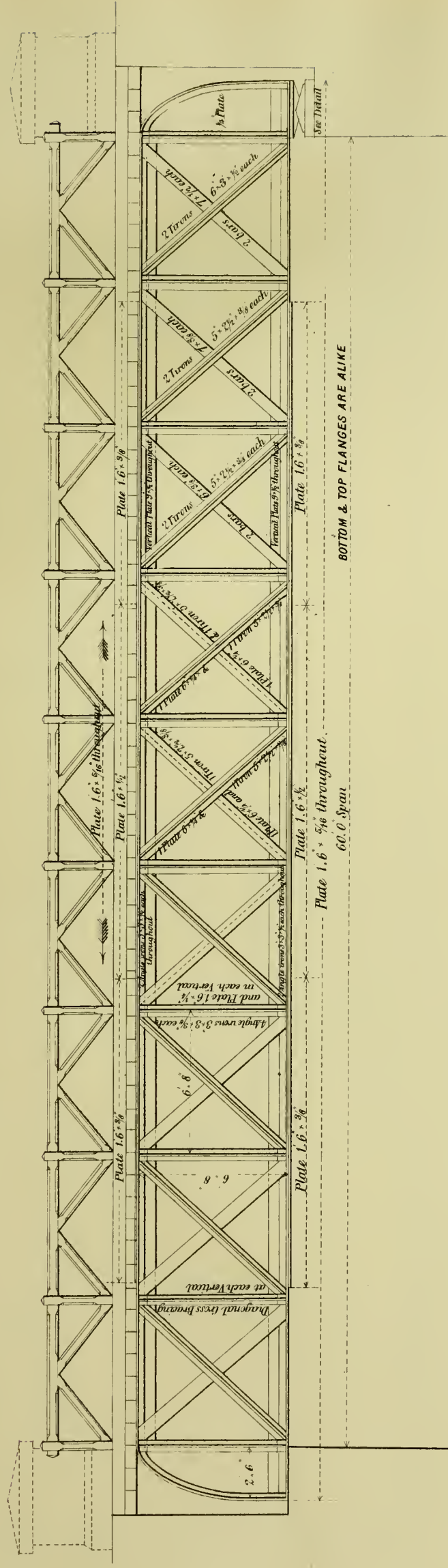
Scale for Details $\frac{1}{2}$ Inch to One Foot



SCALE FOR ENLARGED DETAILS
 $\frac{1}{16}$ Inches to One Foot

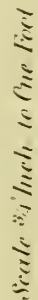


STANDARD GAUGE. 60 FT. SPAN.
DIAGRAM.

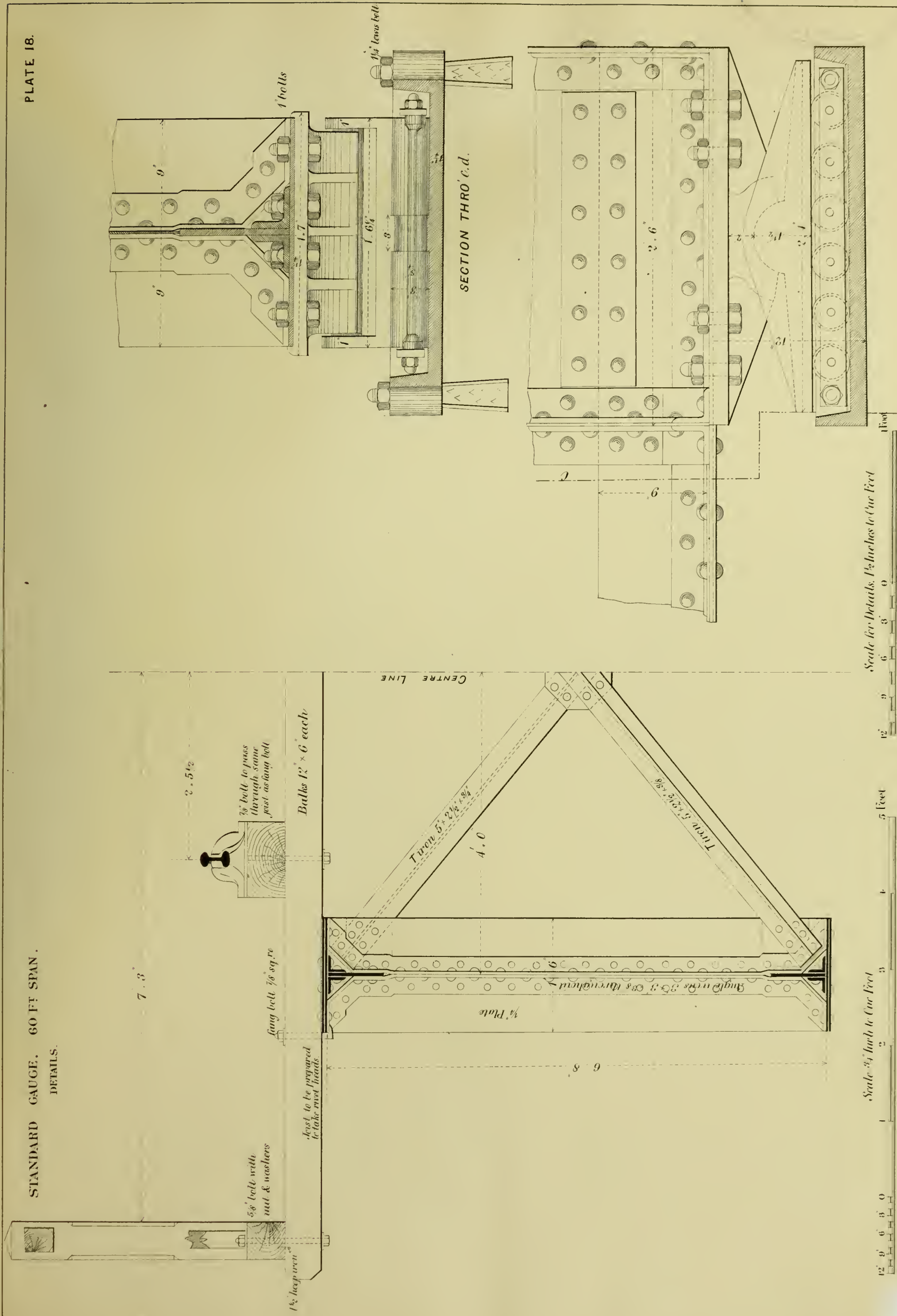


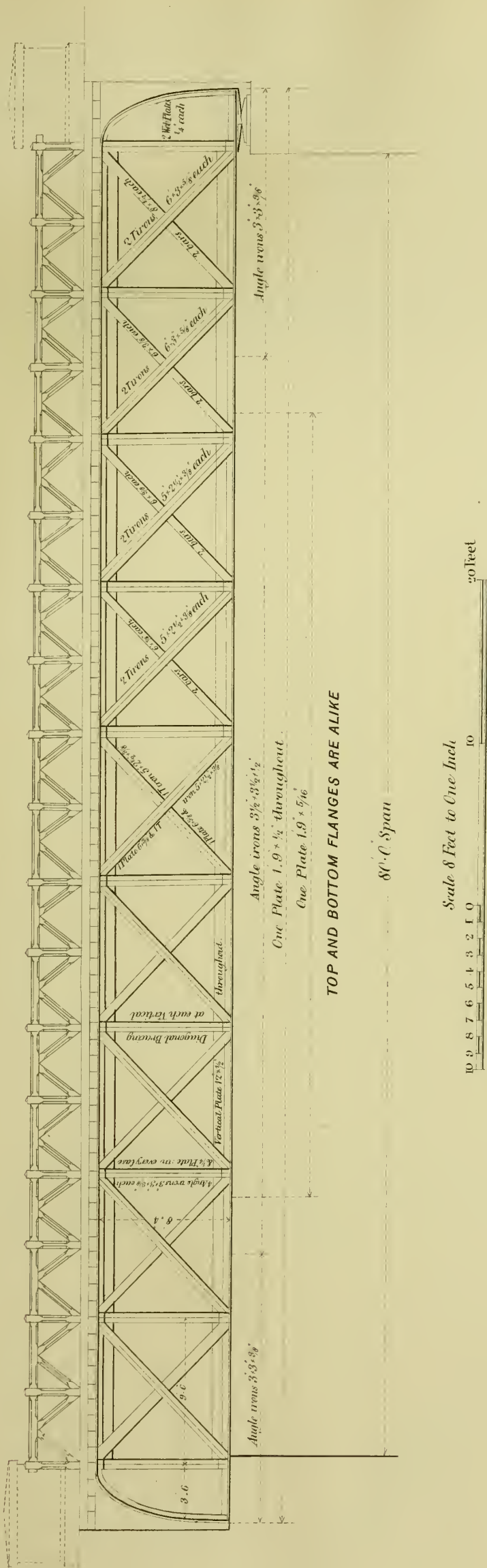
Scale 6 Feet to One Inch

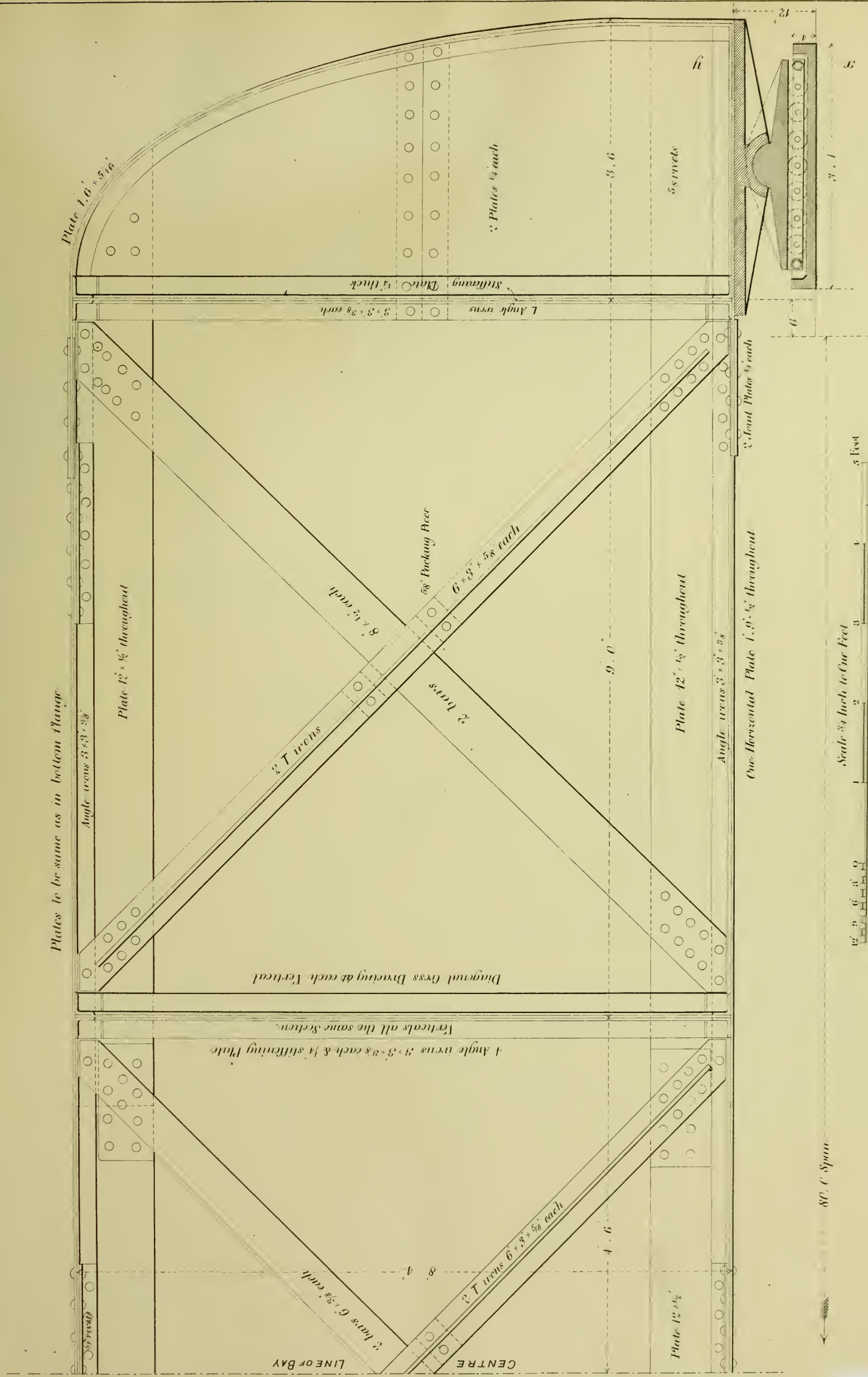


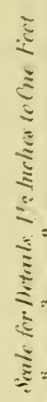


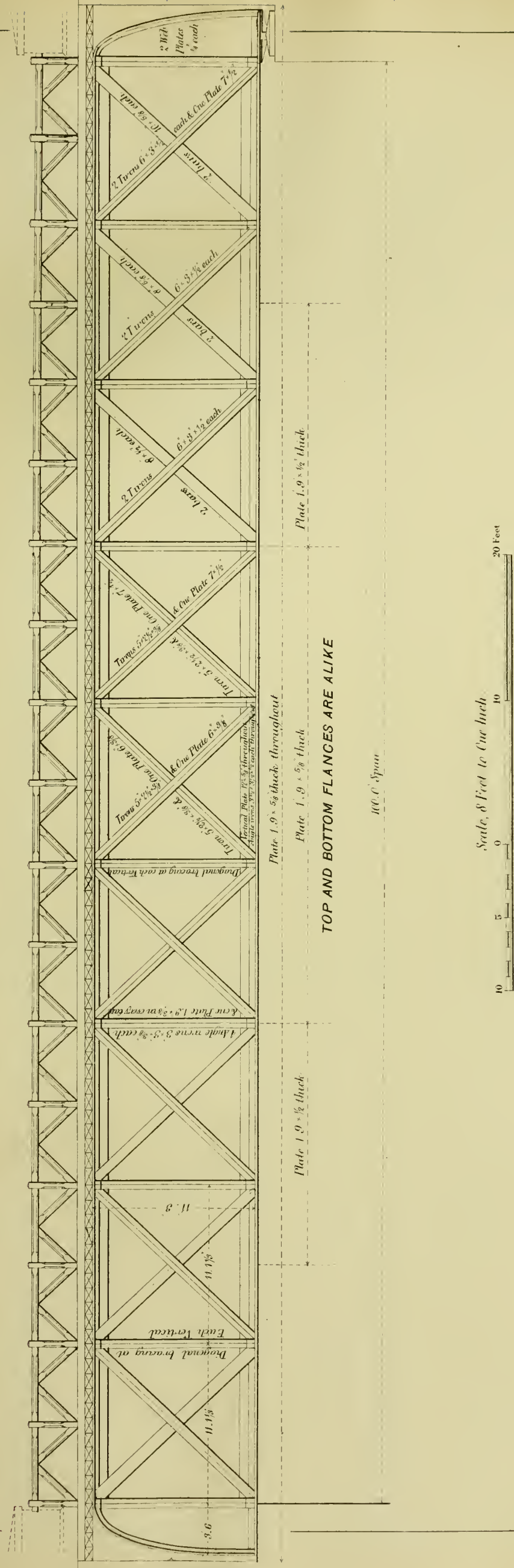
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100



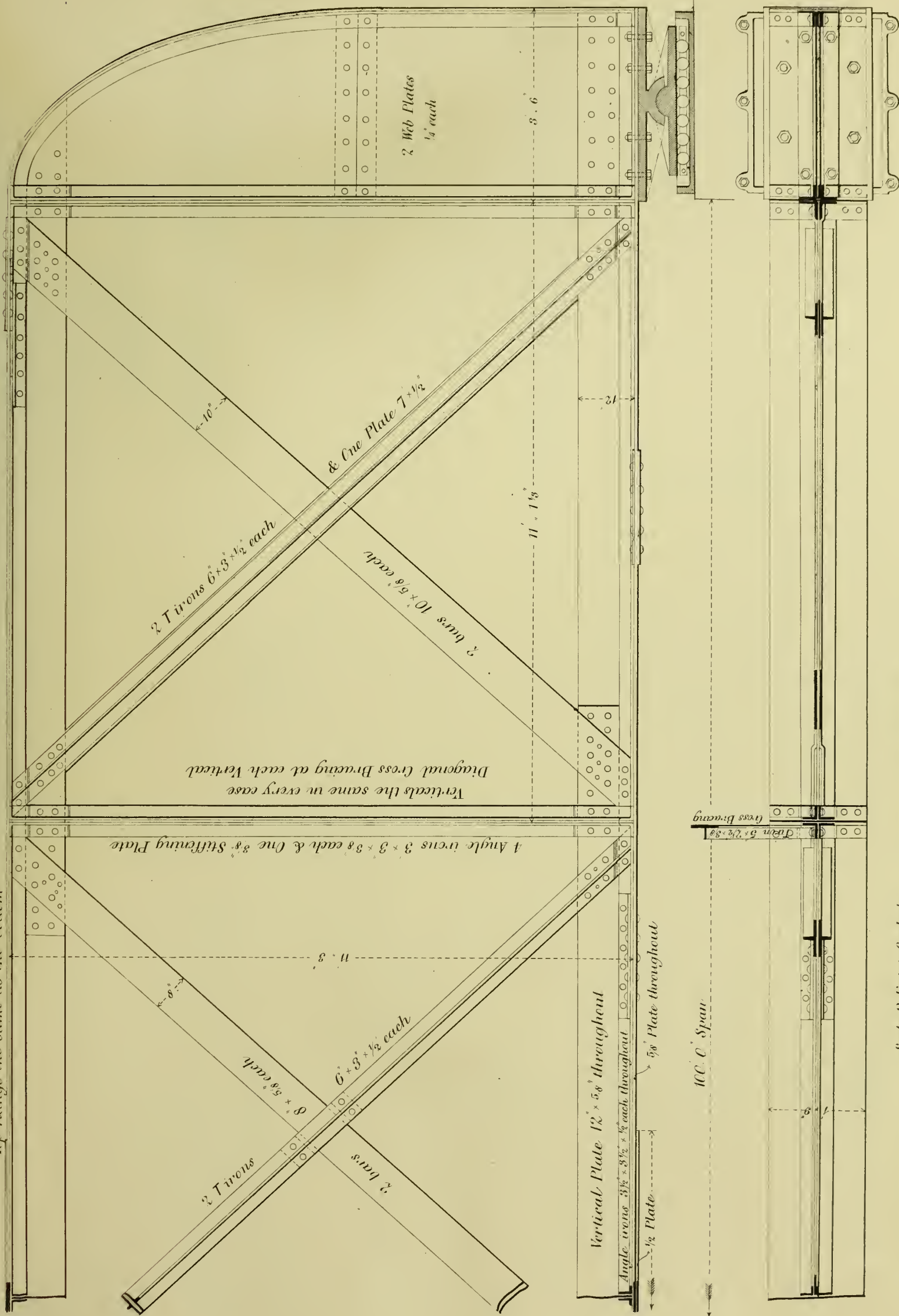




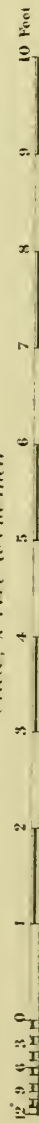




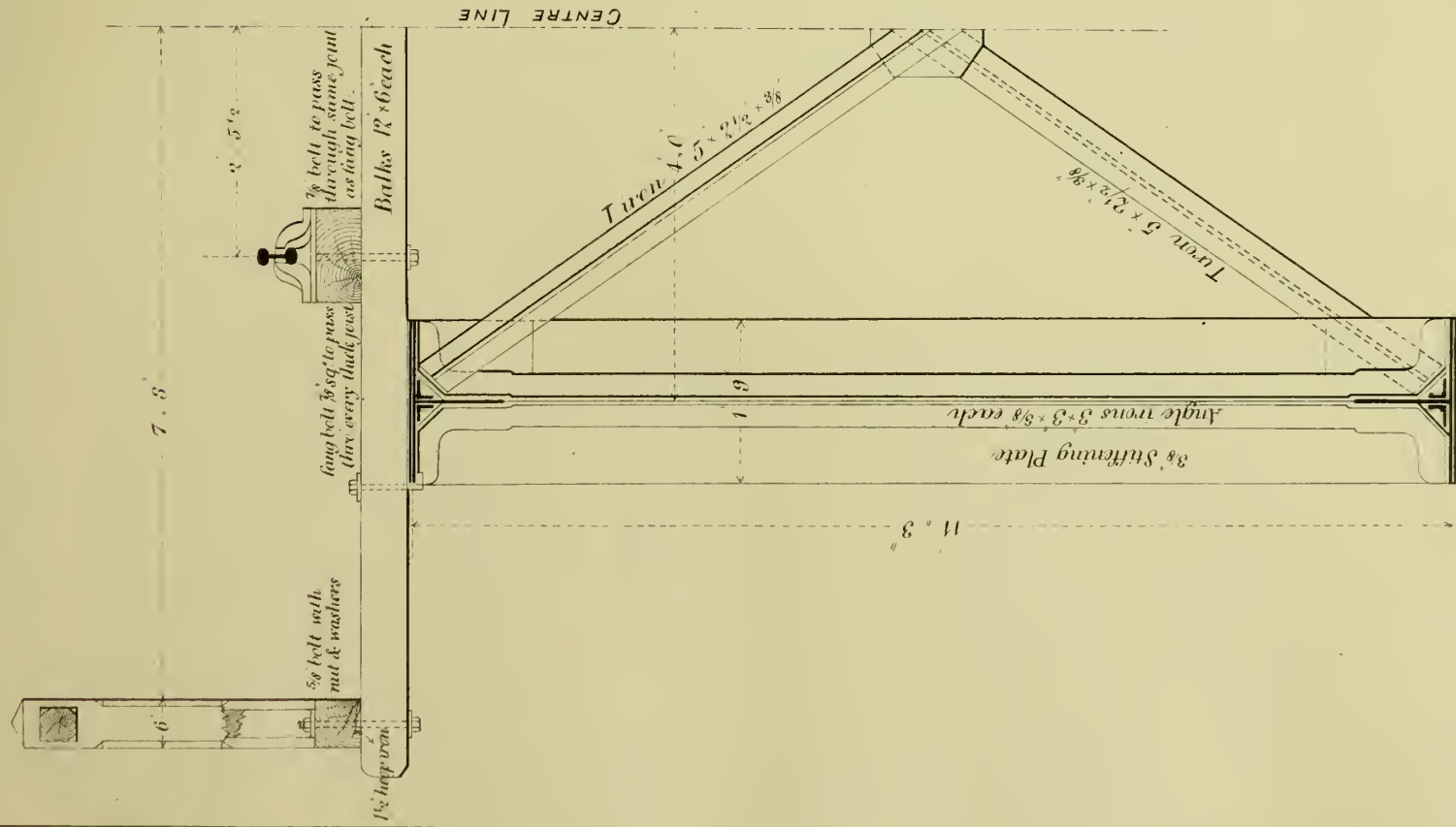
Top flange the same as the bottom



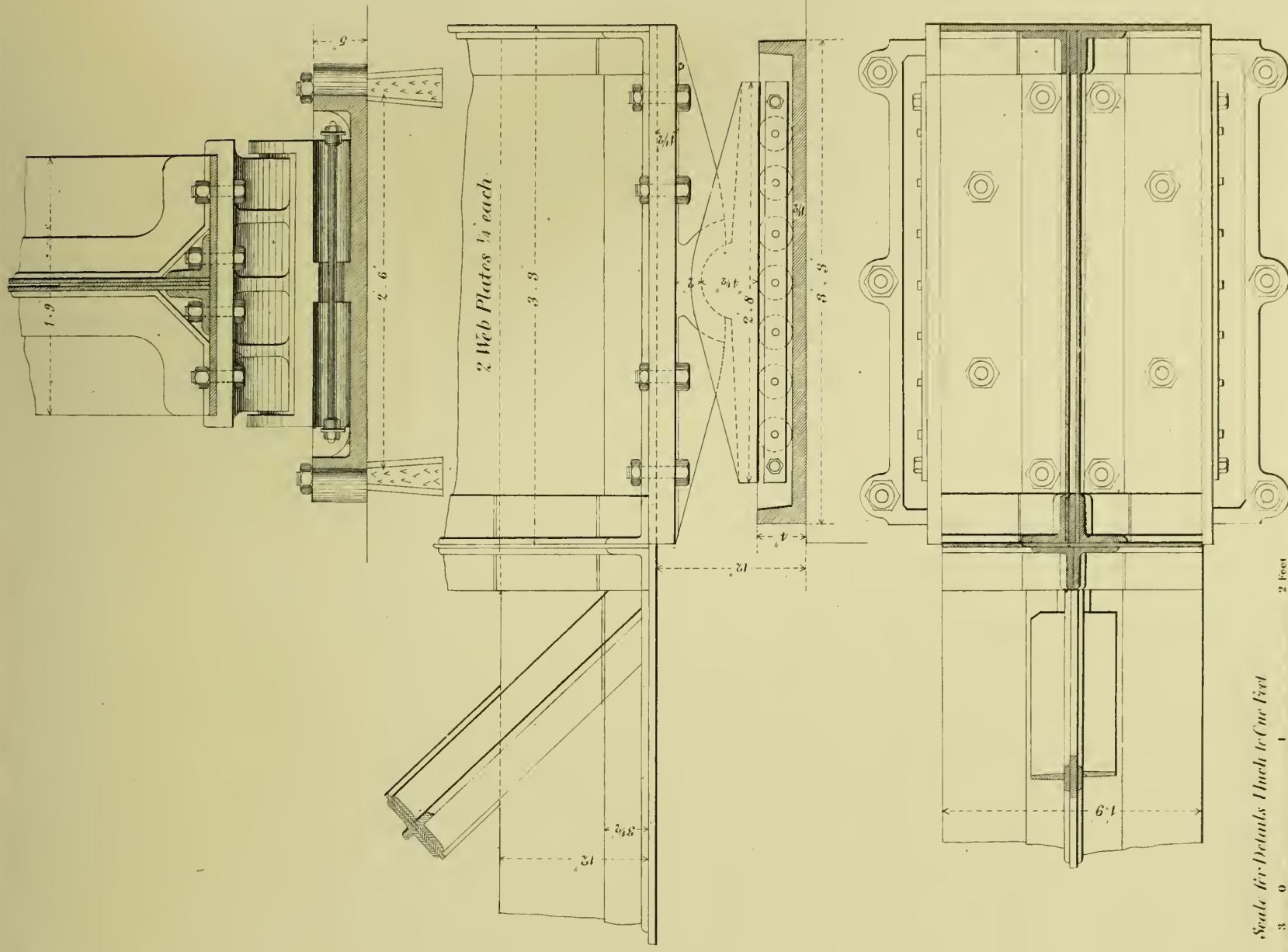
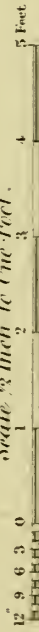
Scale, 2 Feet to One Inch



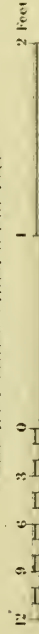
STANDARD GAUGE, 100 FT. SPAN.
DETAILS.



Scale 1/2 inch to one foot.



Scale for Details 1 inch to one foot.

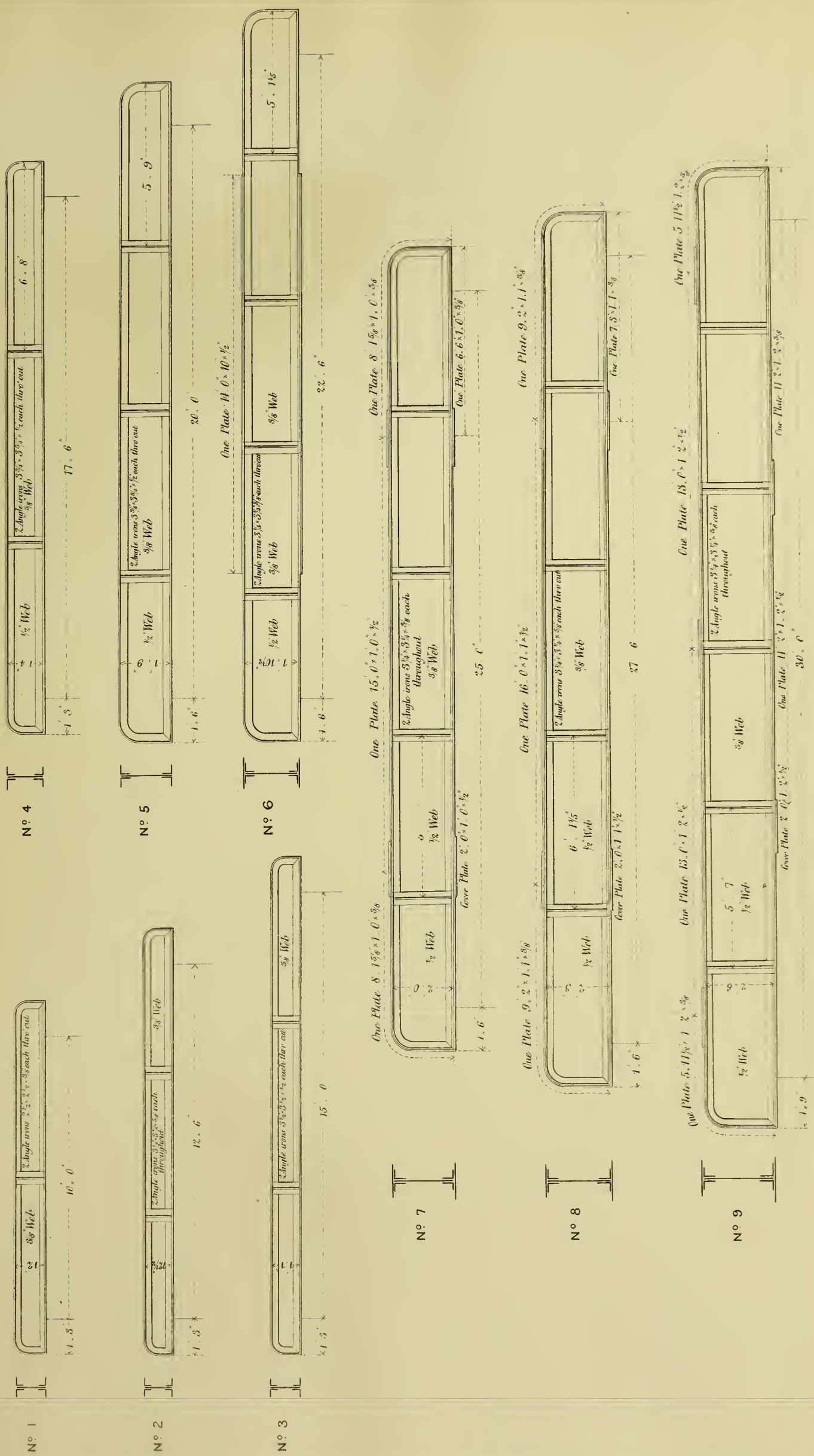
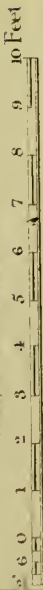


WROUGHT IRON GIRDERS — 10 FT. TO 30 FT. SPANS.

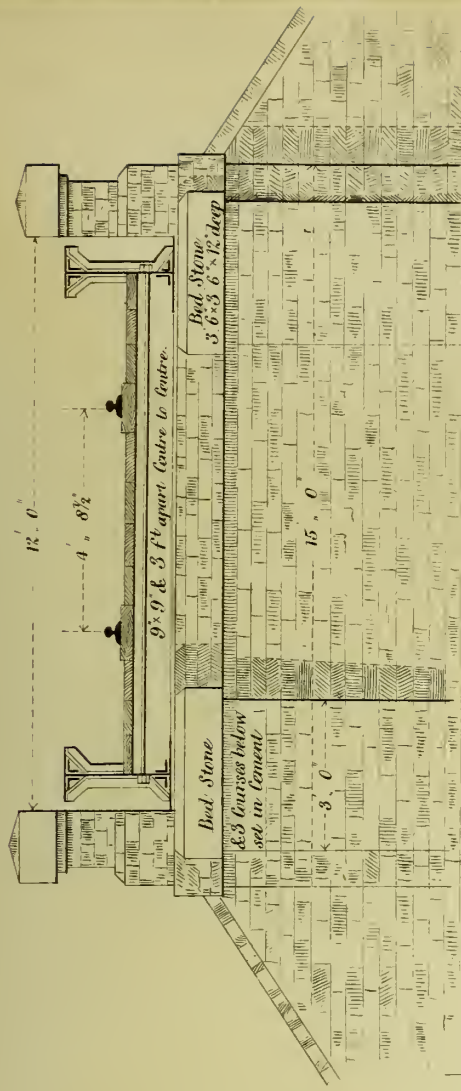
EACH GIRDER TO CARRY ONE TON ON EACH FOOT OF ITS SPAN (INCLUDING ITS OWN WEIGHT)

STRAIN NOT TO EXCEED 5 TONS ON THE SQUARE INCH—AFTER DEDUCTING RIVET HOLES.

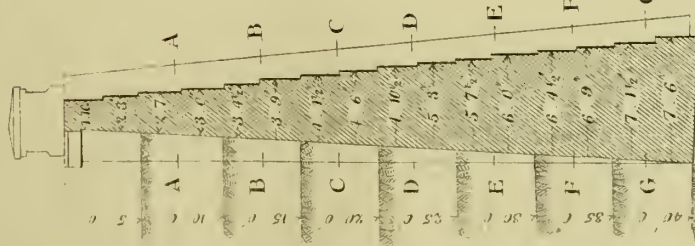
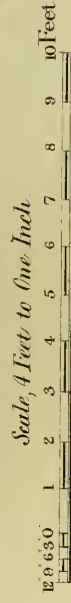
Scale, 4 Feet to One Inch



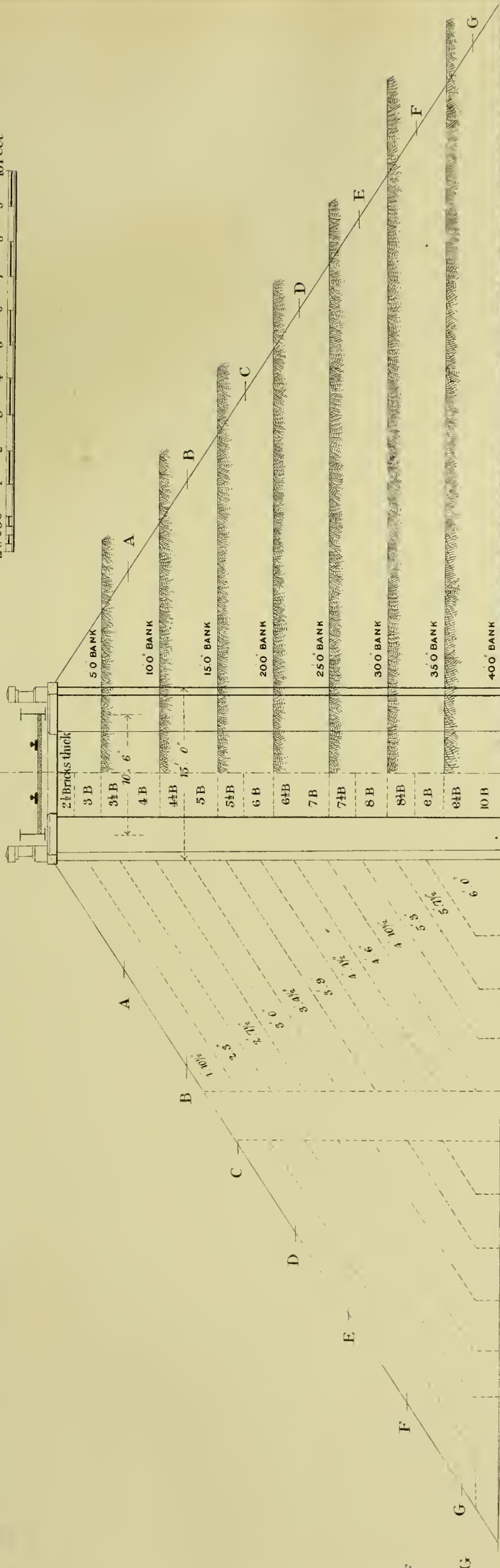
ONE GENERAL ABUTMENT



Scale for General Drawing 12 Feet to One Inch

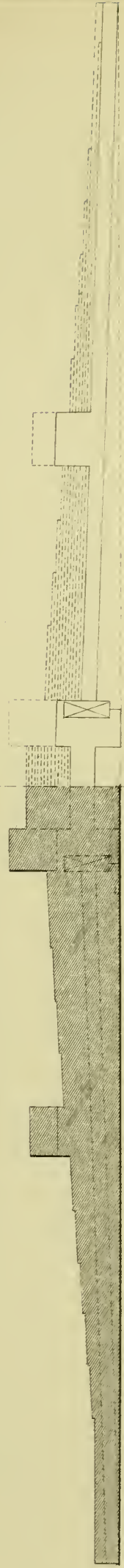


CROSS SECTION AT CENTRE



ELEVATION

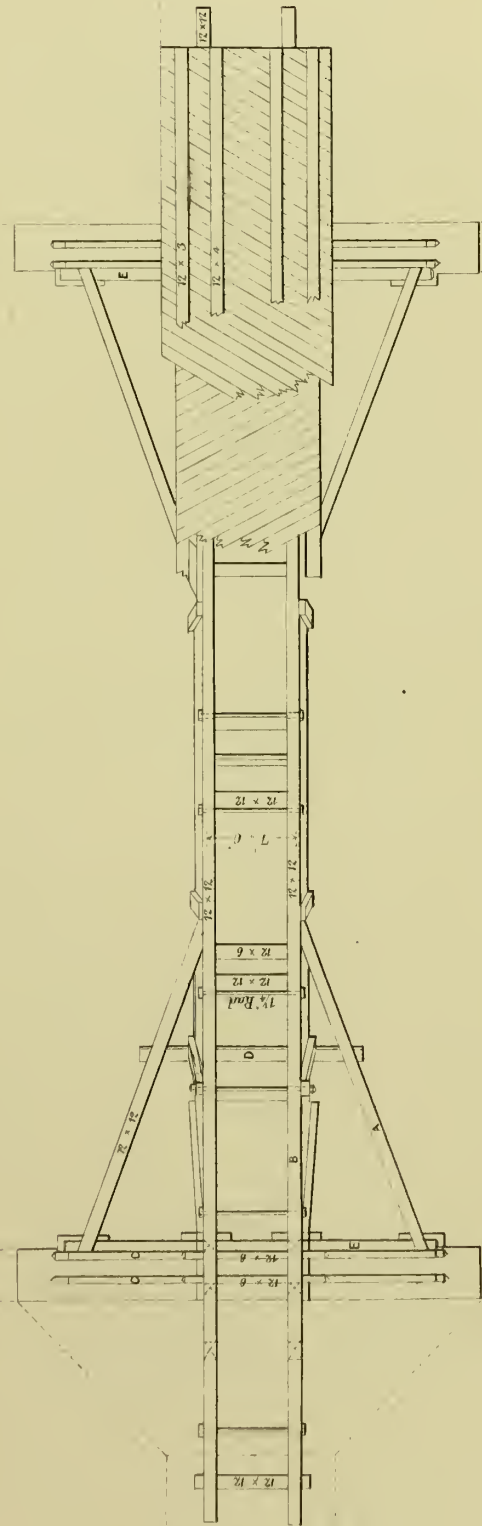
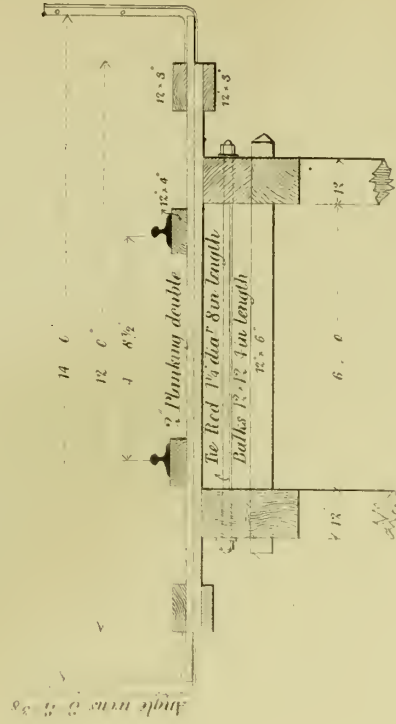
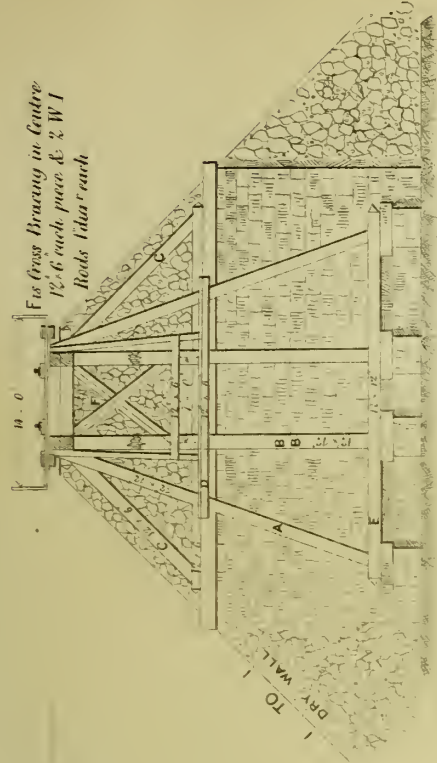
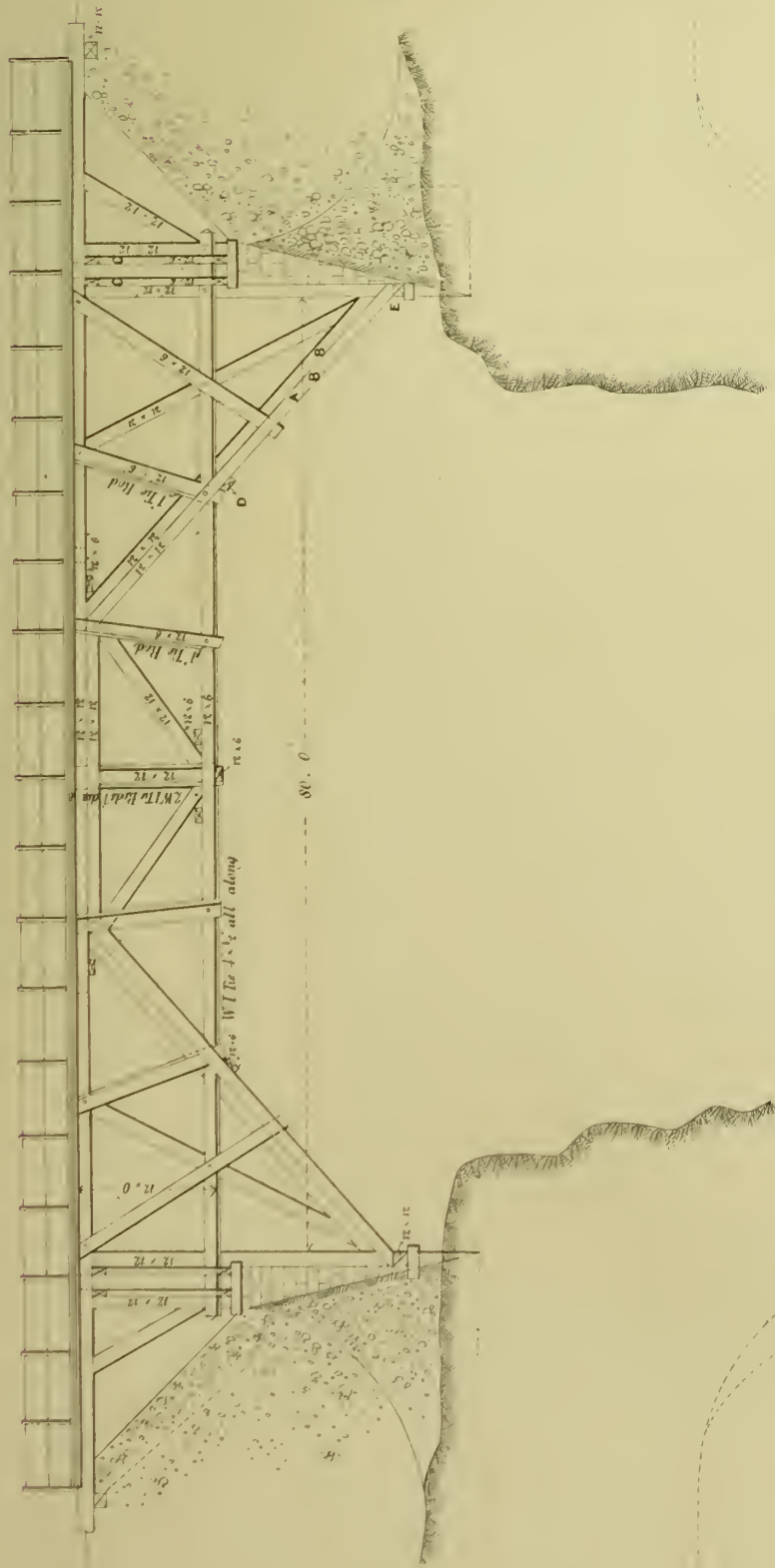
Showing thicknesses of Wall. Showing heights of Banks



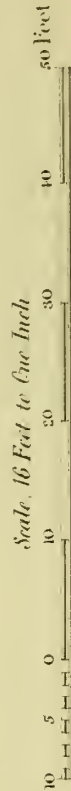
PLAN

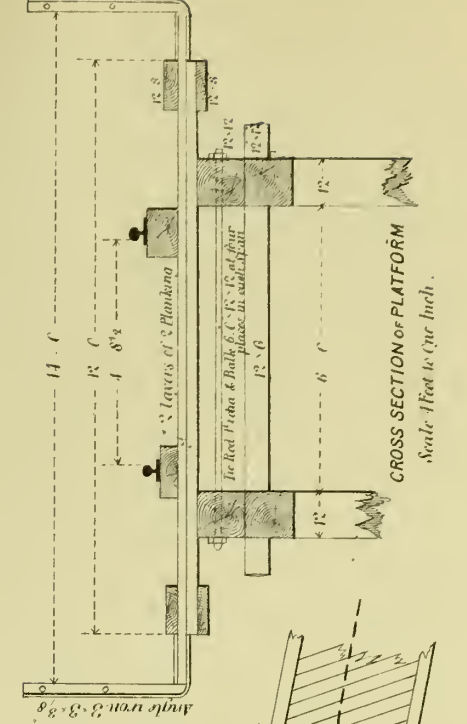
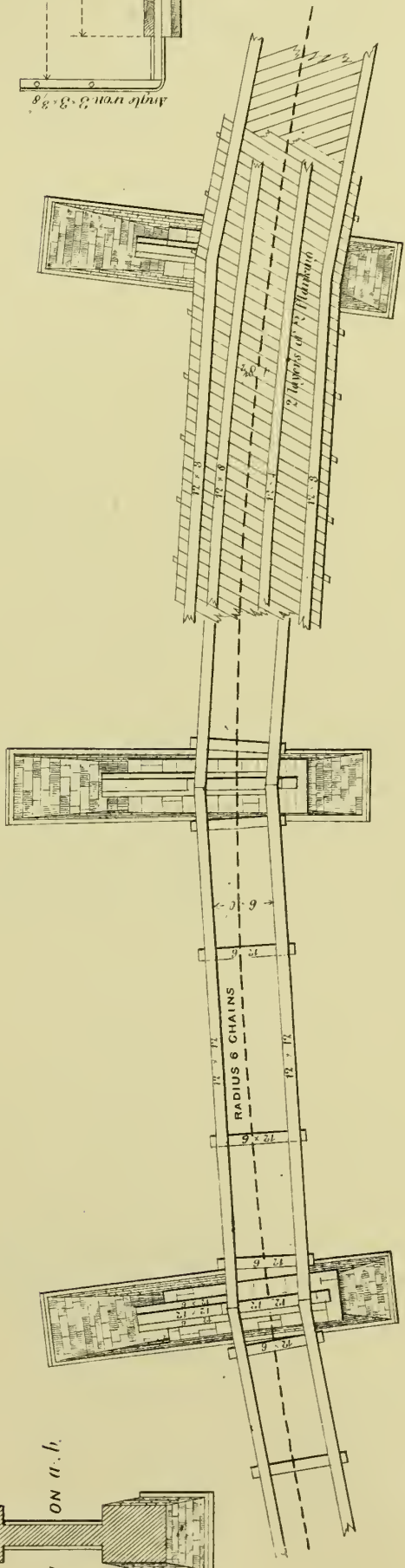
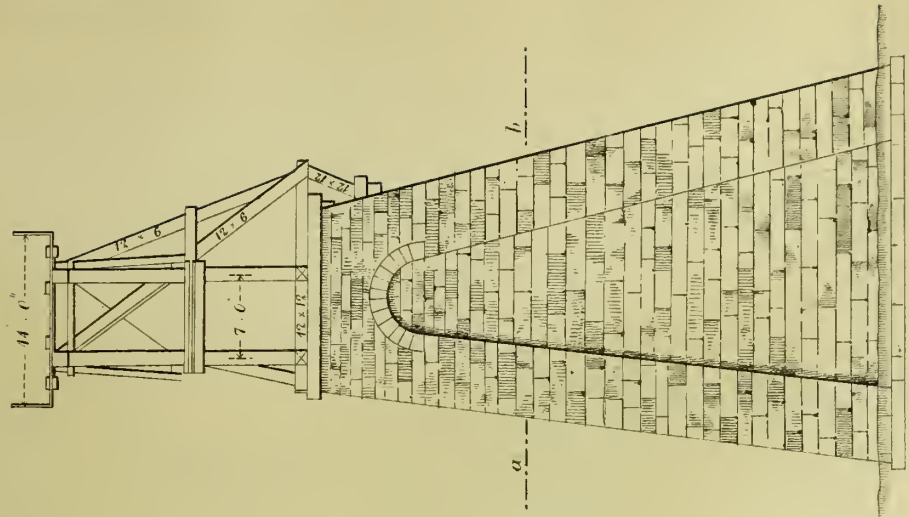
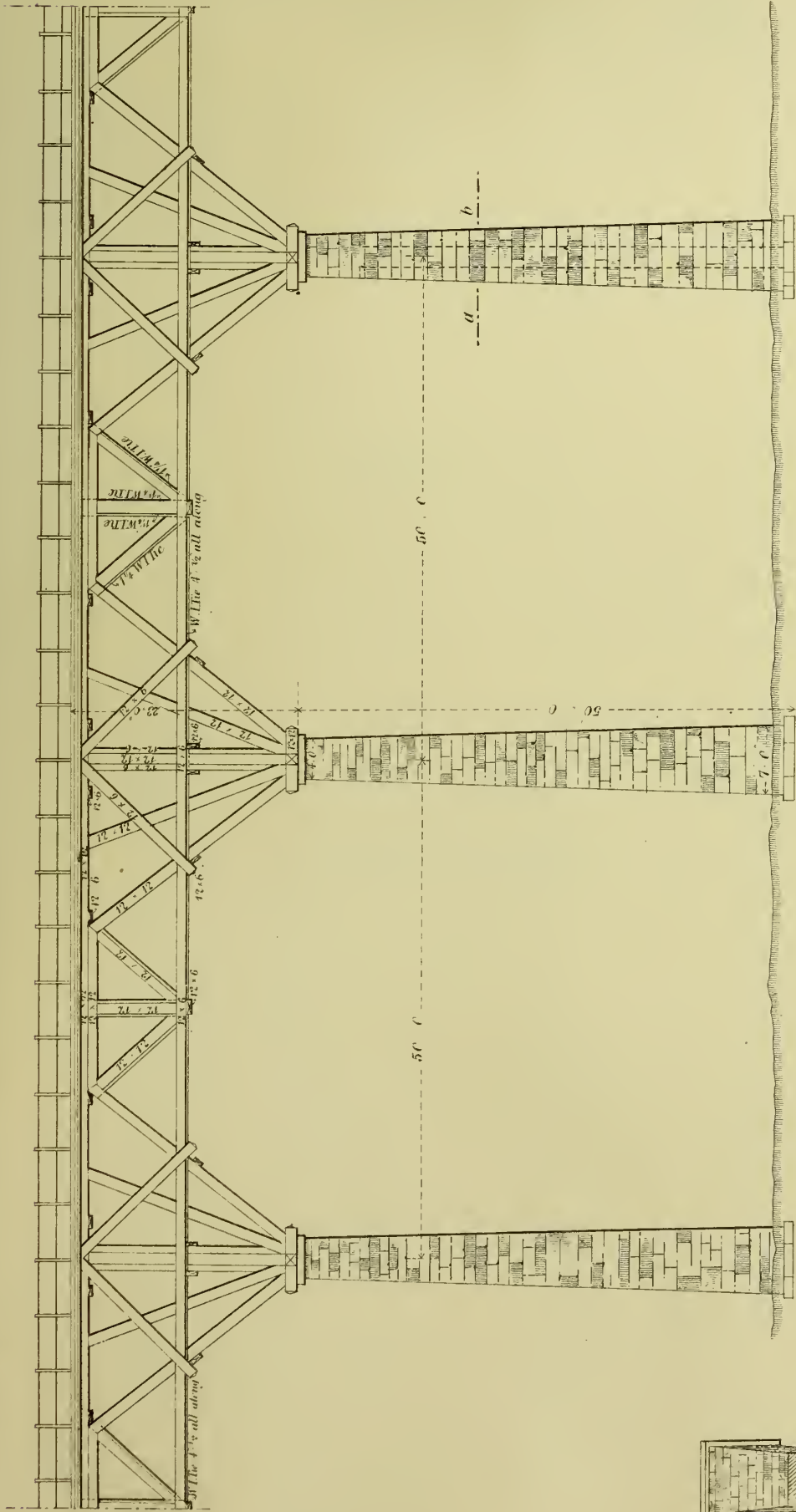
above Foundation & on top

STANDARD GAUGE - 80 FT SPAN - TIMBER TRUSS



All Tie Belts 1 1/2 dia"



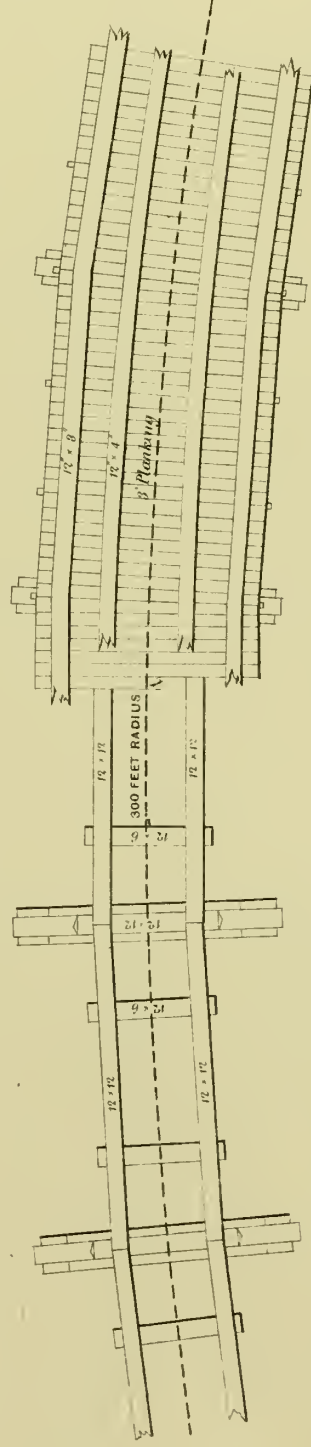
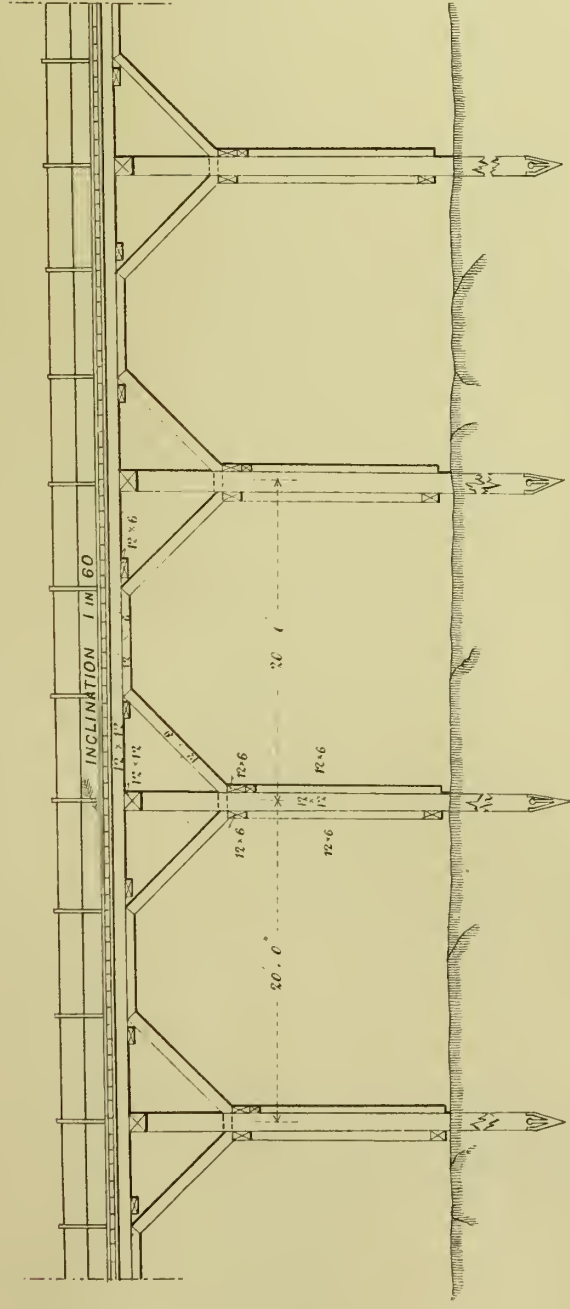


Scale 1/4" to 1" high

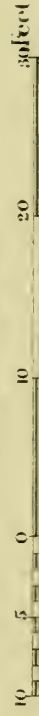


All Belts 1 1/2" dia

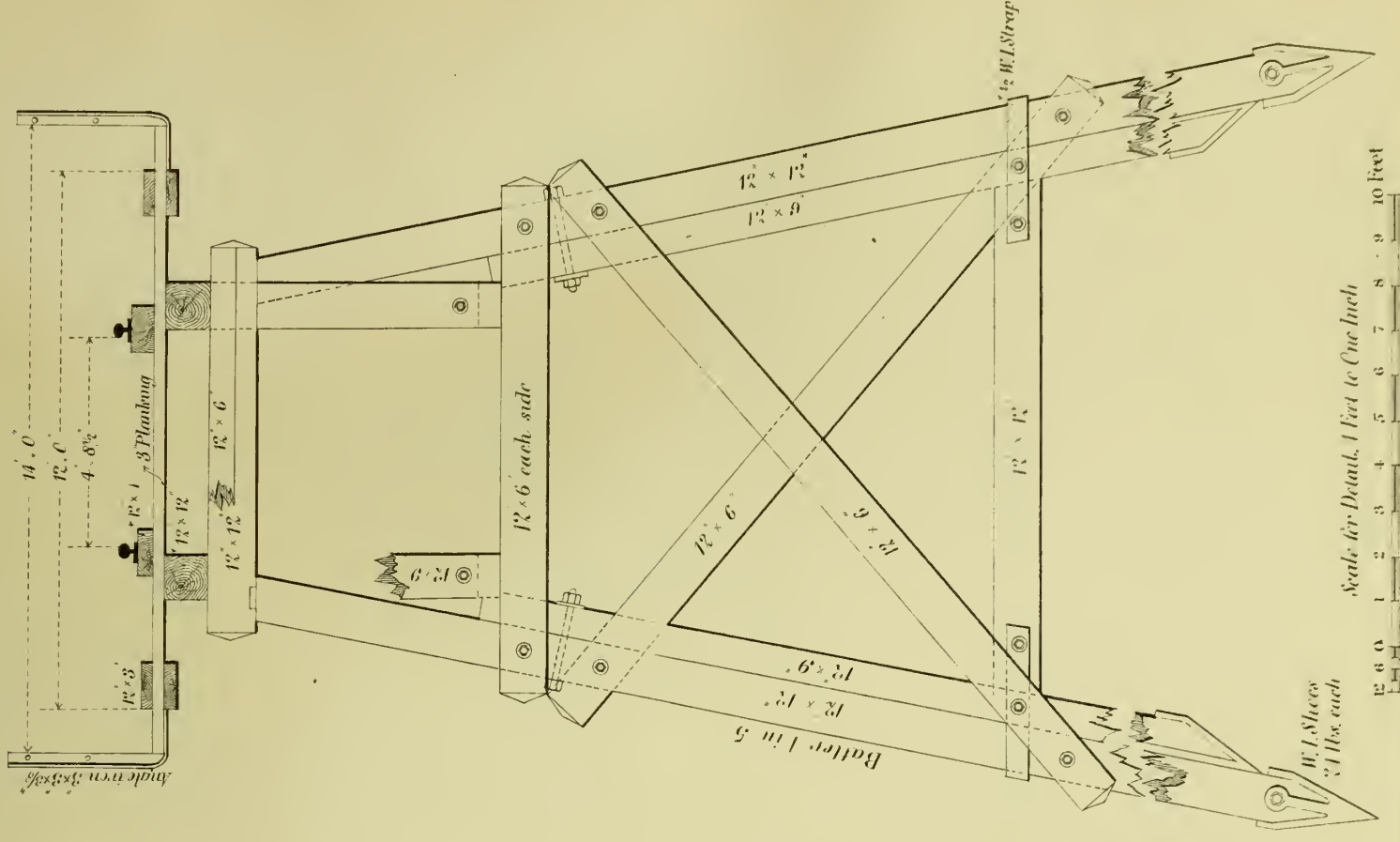
STANDARD GAUGE, 20 FT SPAN TIMBER VIADUCT.



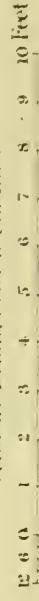
Scale, 1/2" Feet to One Inch



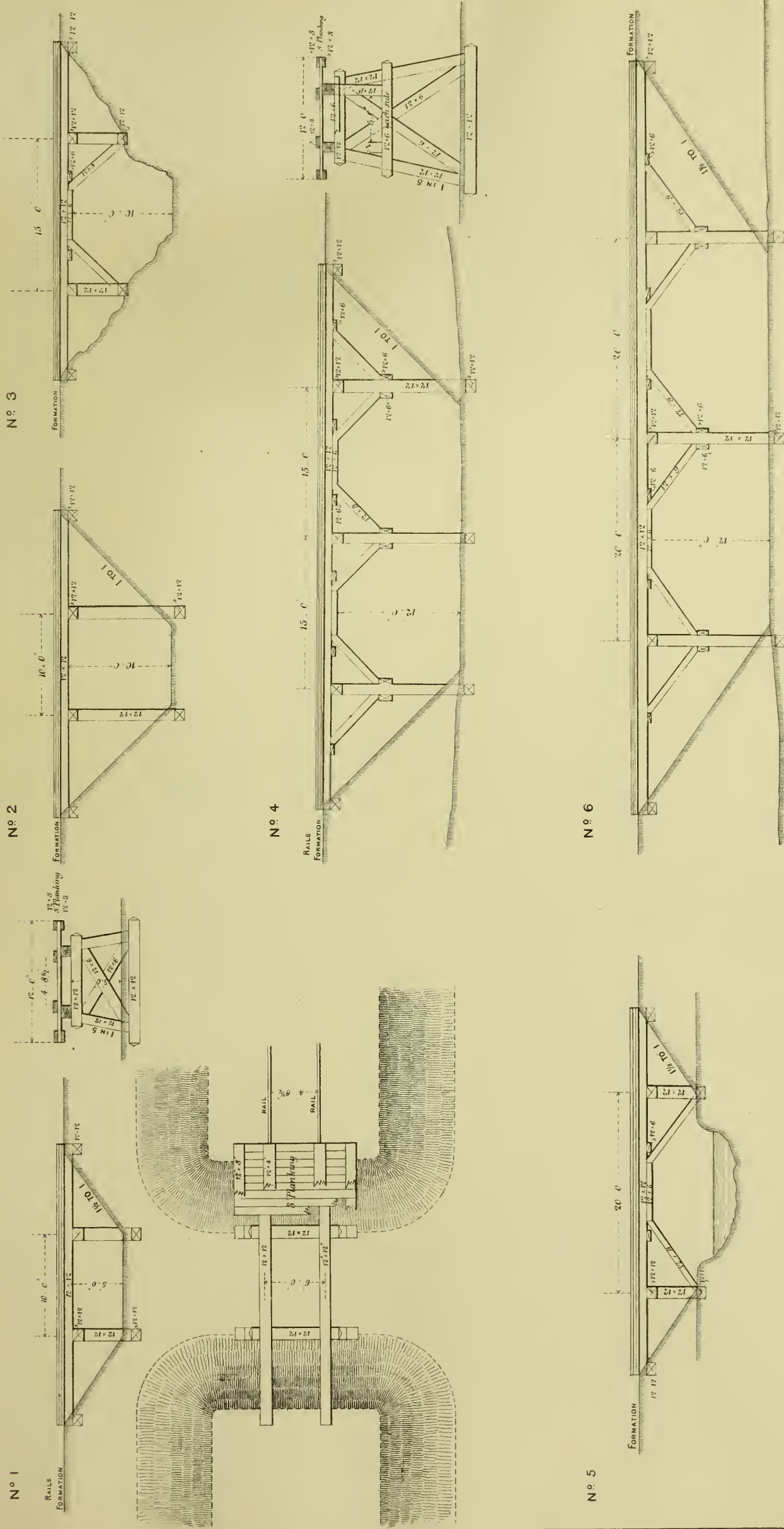
All Belts 1 1/2" diam



Scale for Detail, 1 Foot to One Inch



Timber Openings for Foot paths, Culverts, Cattle-creeps, &c.

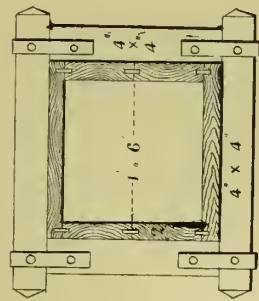
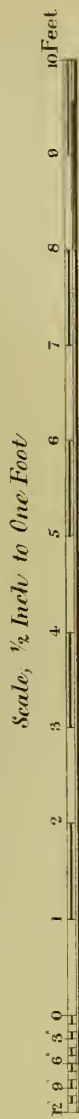
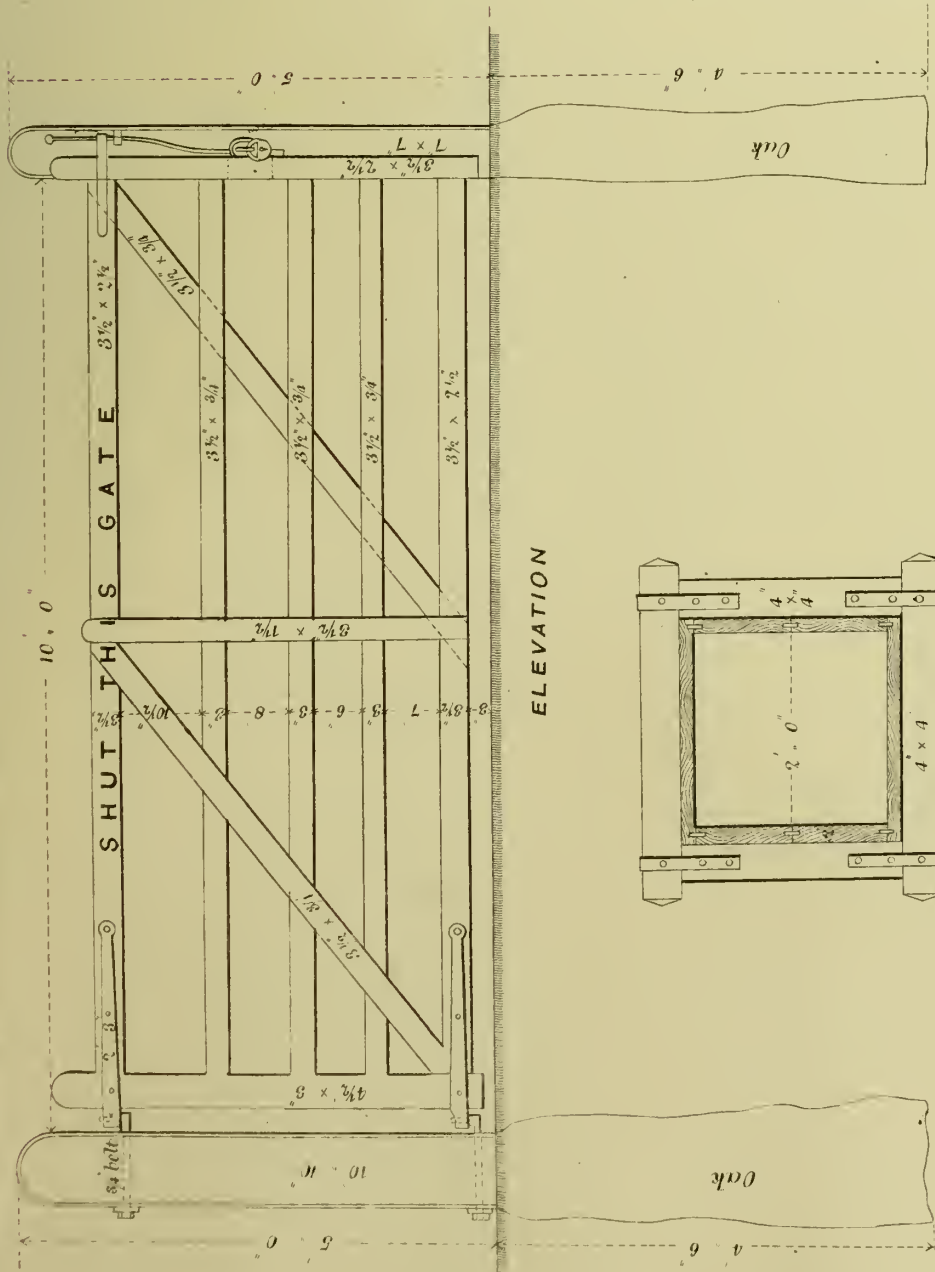


All Belts 1 1/2" dia

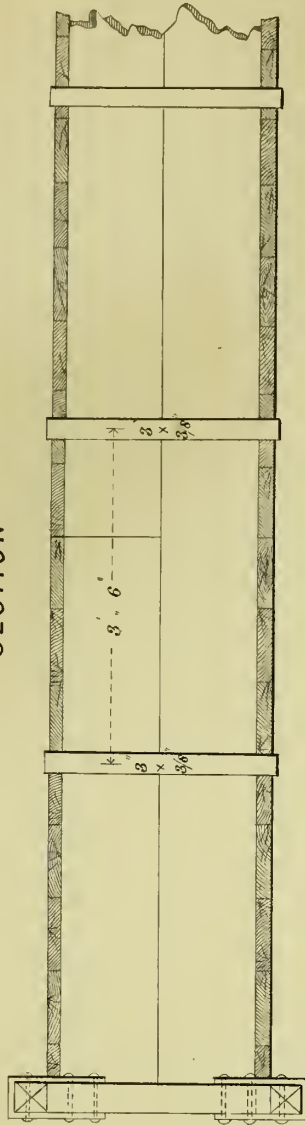
Scale, 12 Feet to One Inch



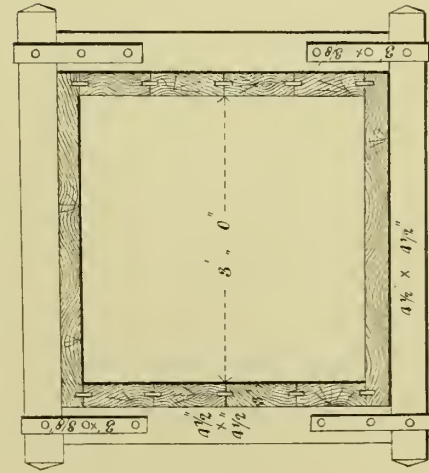
TIMBER TRUNKS & OCCUPATION GATE.



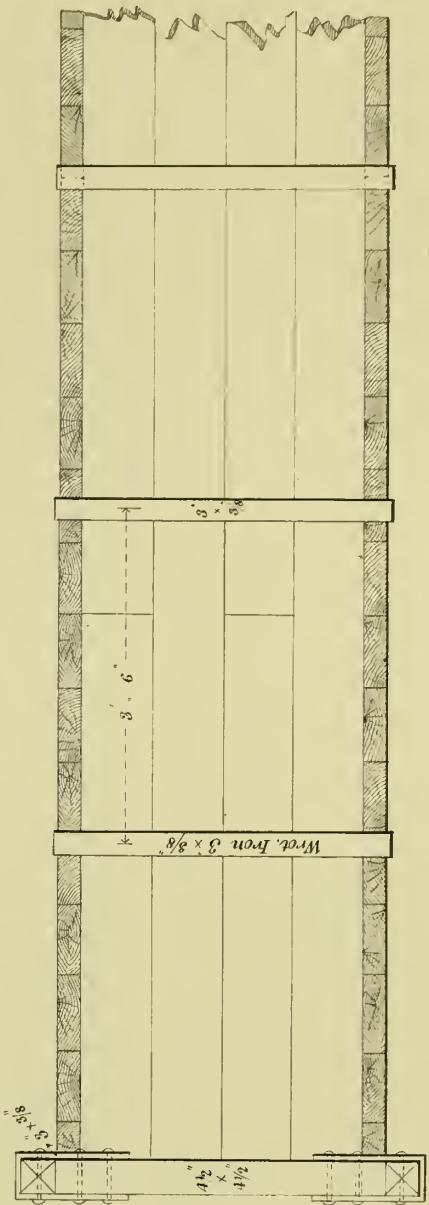
SECTION



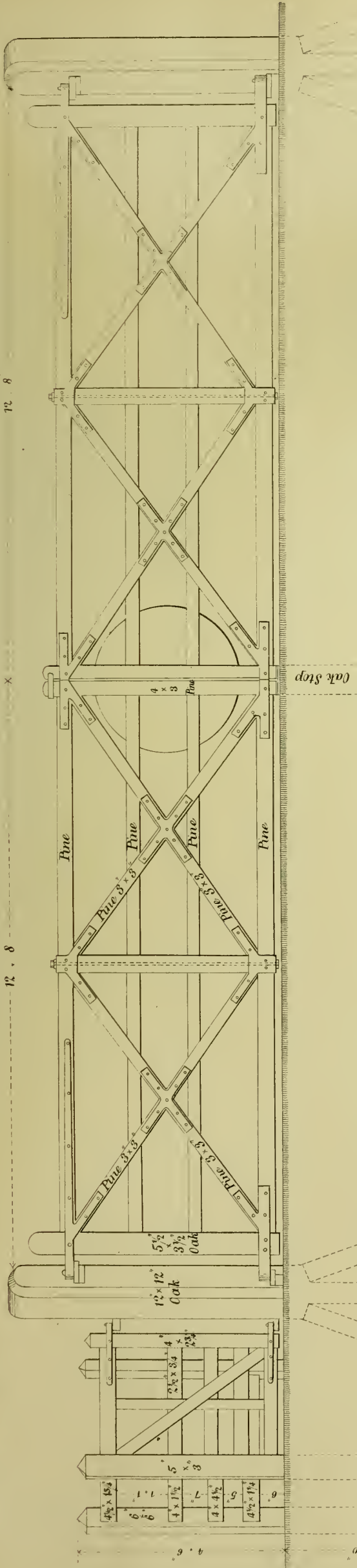
ELEVATION



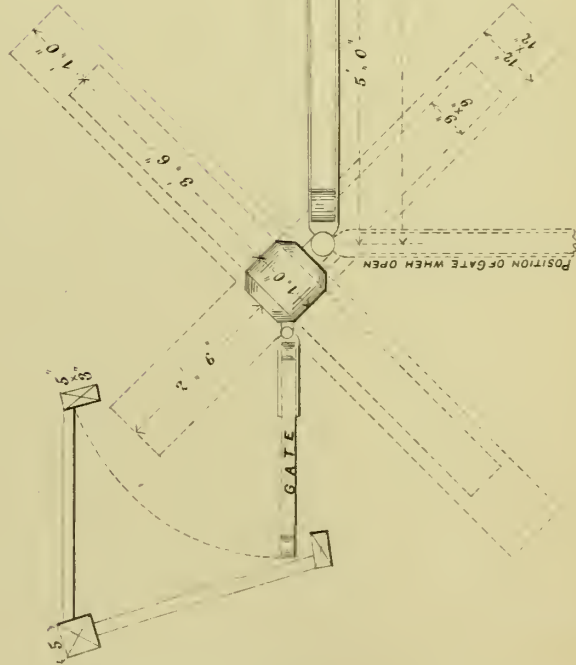
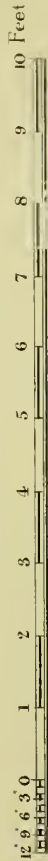
SECTION

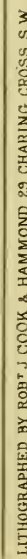


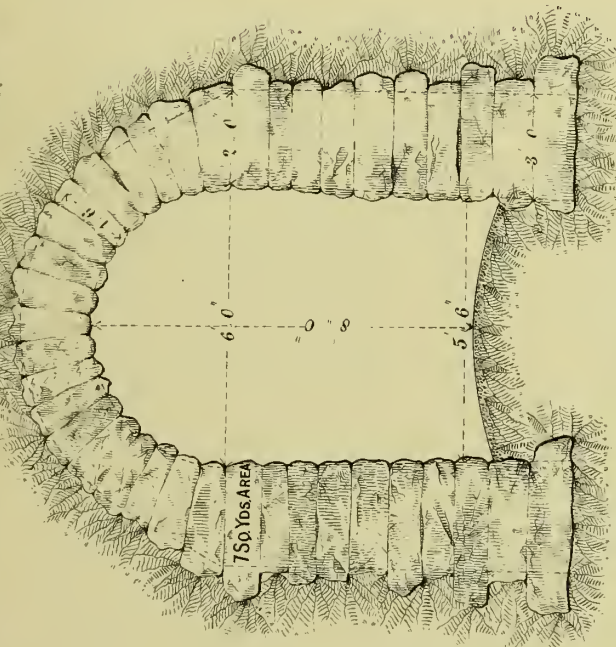
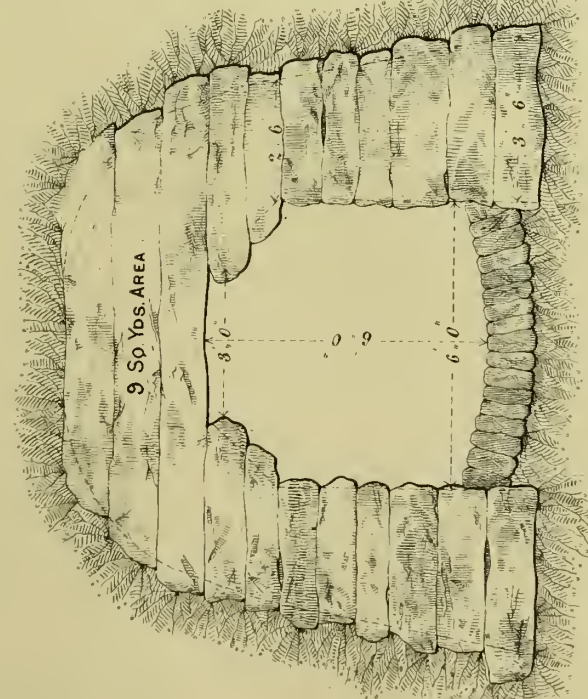
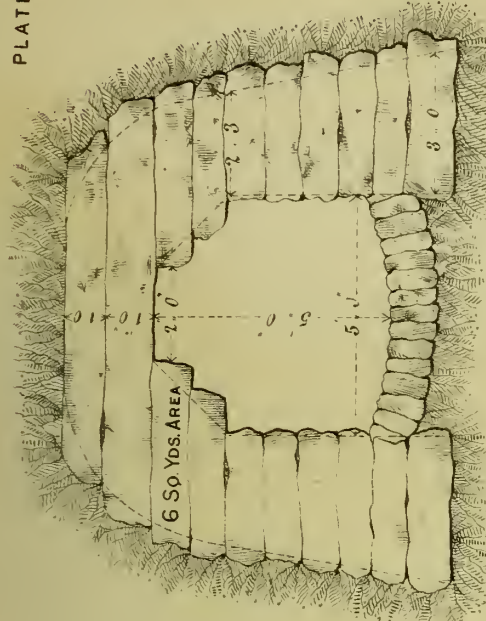
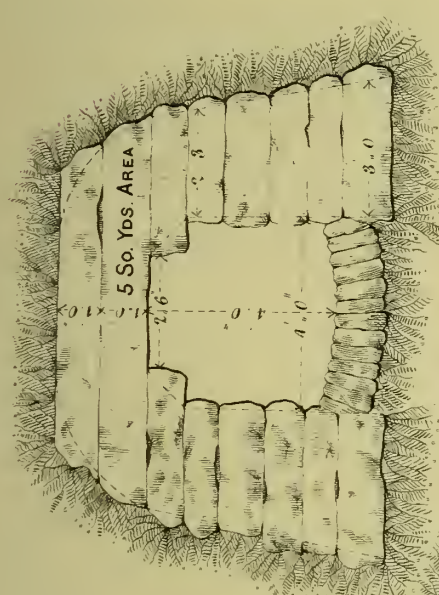
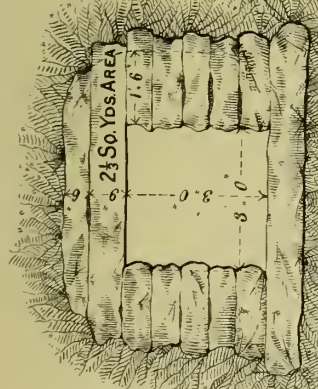
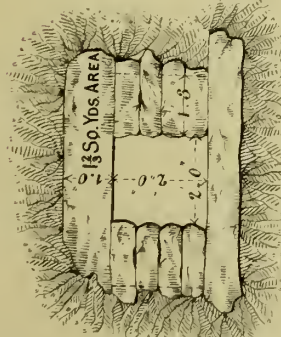
ELEVATION



Scale, $\frac{3}{8}$ Inch to One Foot.

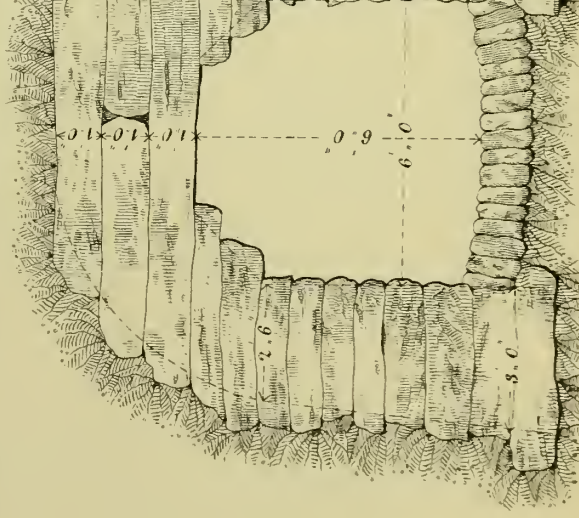
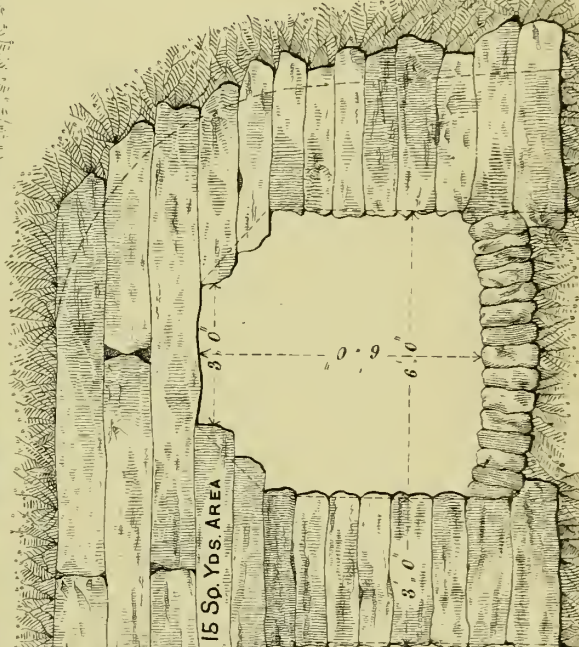
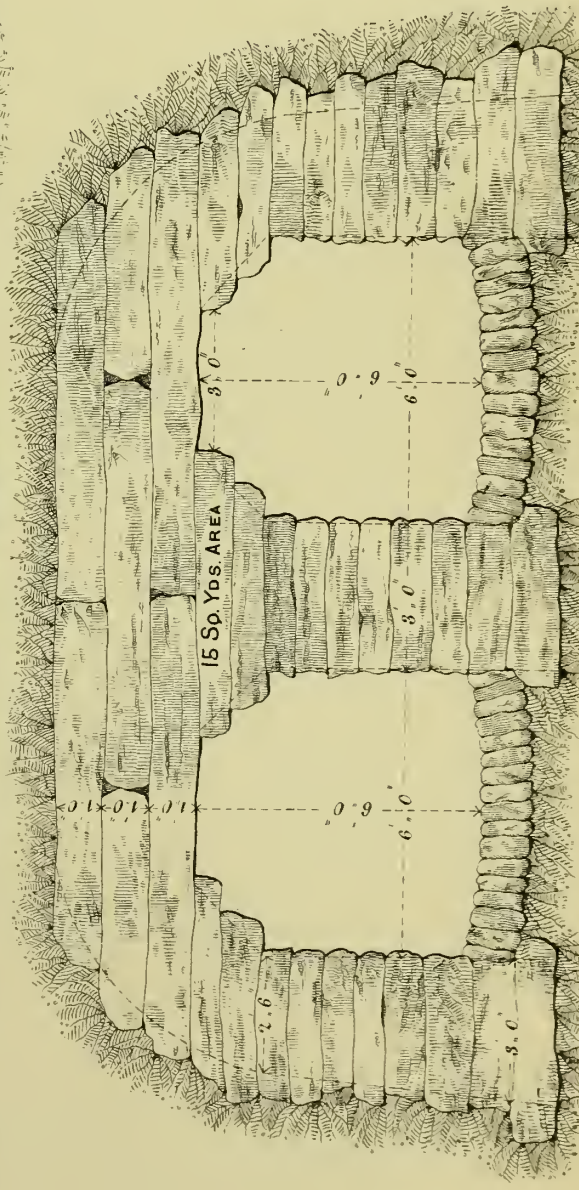






Scale, 4 Feet to One Inch.

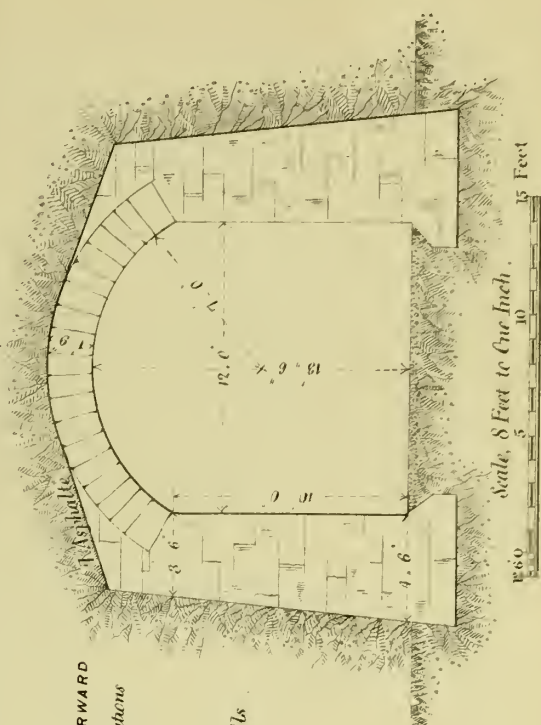
These Gulverts & Cattle Arches to be built in unwrought Stone in rough potted work with scabbling hammer.
The Parts within the dotted lines to be set in Mortar.
The Pitching to be laid dry.



Occupation Bridge GENERAL SECTION

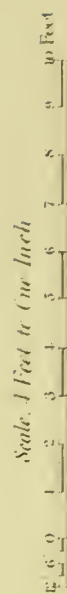
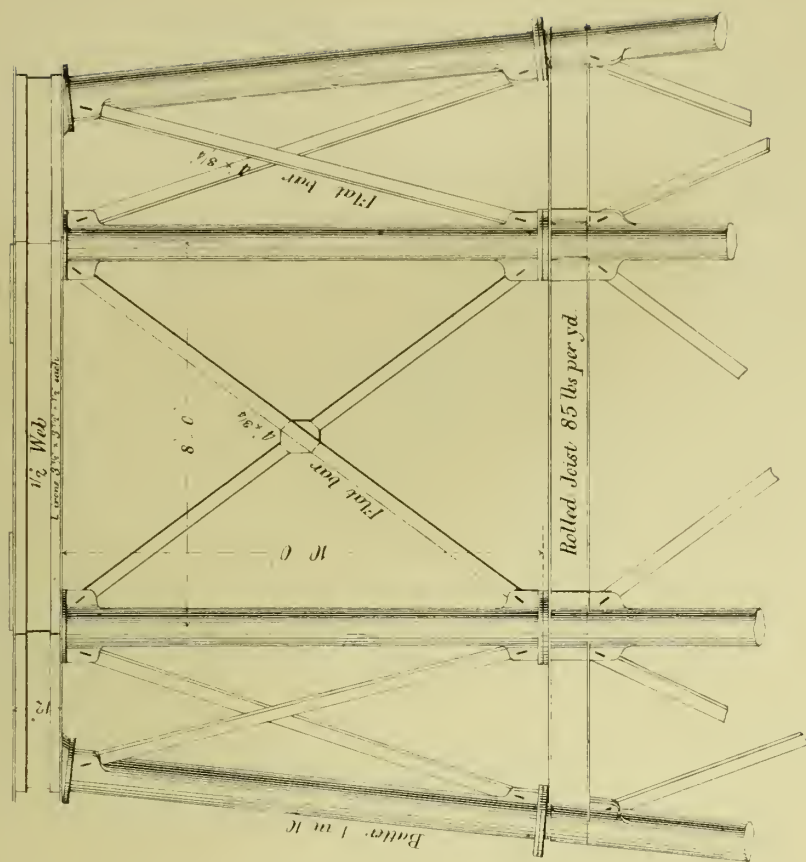
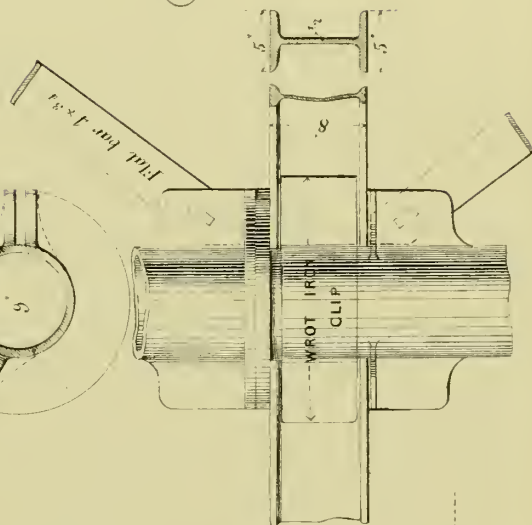
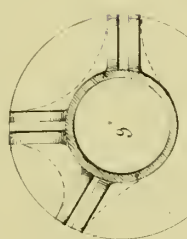
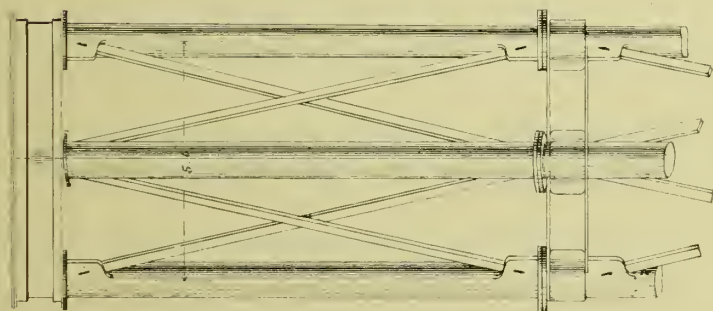
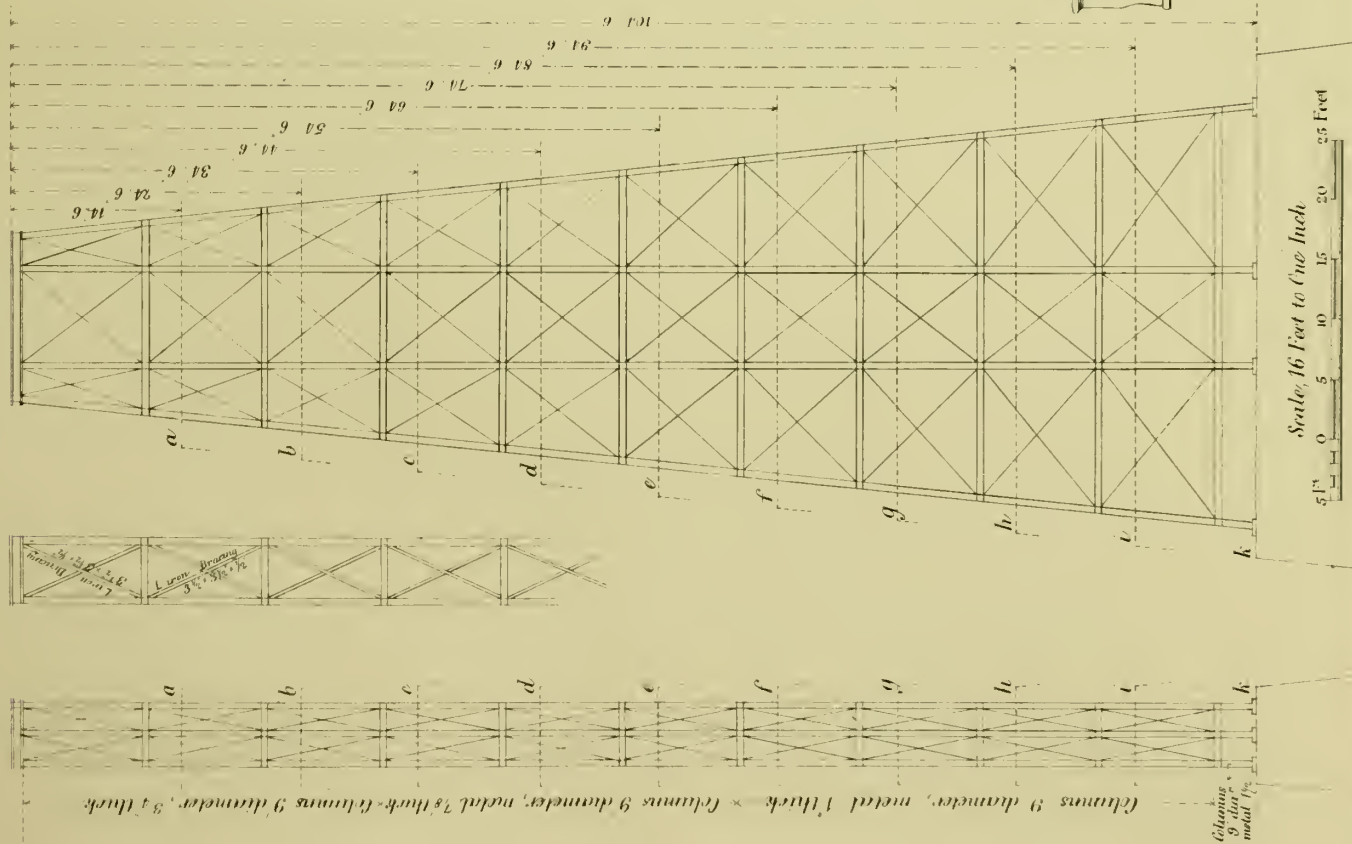
ASHLAR MASONRY. TOOLED BEDS & JOINTS. FACE ROUGH.

FOR ONE YARD FORWARD
 Excavation in Foundations 3 c. yds.
 Masonry in Arch 3 1/2 c. yds.
 Masonry in side Walls 13 1/2 c. yds.
 Asphalt 6 1/2 sq. yds.



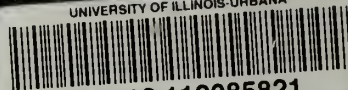
Scale, 8 Feet to One Inch.

GENERAL IRON PIERS
FROM 15 FT TO 105 FT HIGH



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